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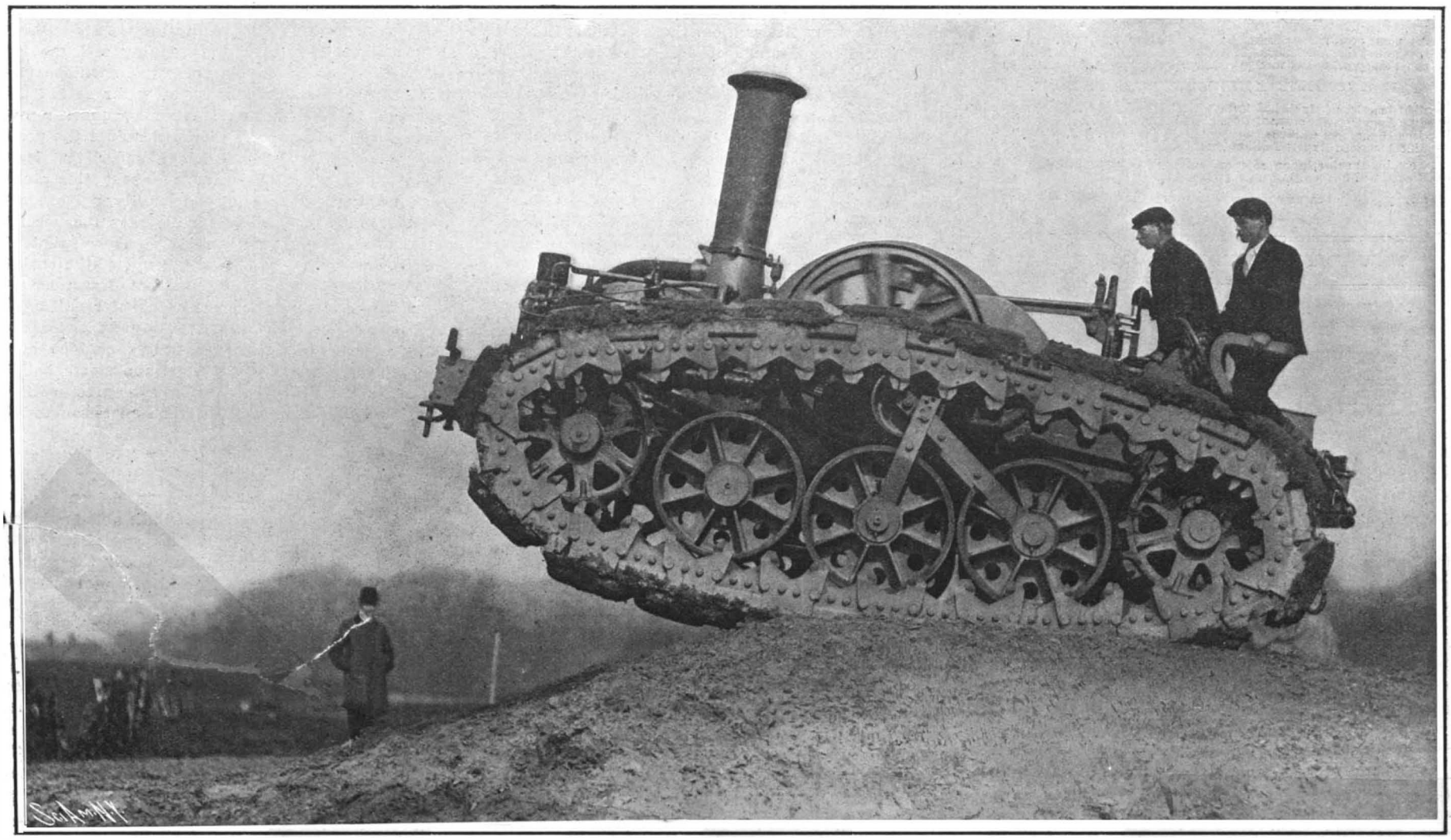

The Caterpillar Motor, Showing the Weight-Carrying Wheels.

A 35-Horse-Power Caterpillar Motor Crossing a Brook on Its Own Bridge.

A CURIOUS MEANS OF PROPULSION.—[See page 348.]

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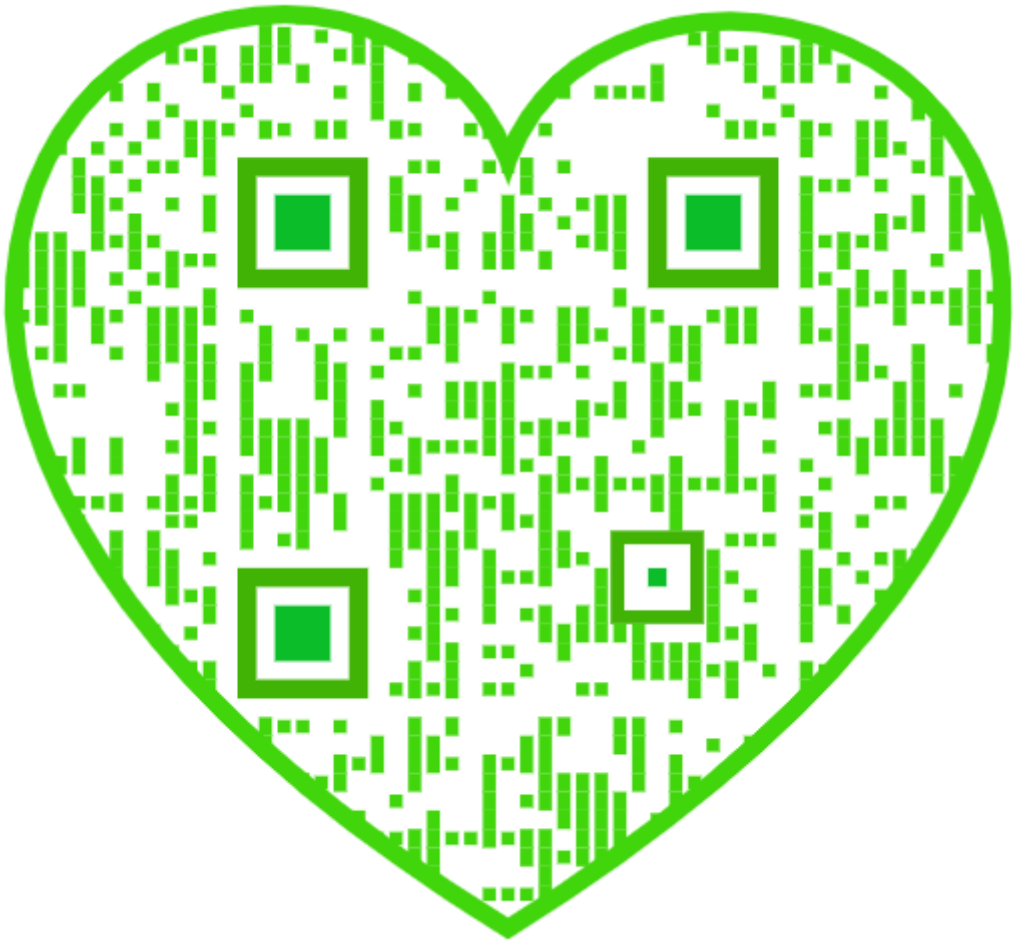

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NEW YORK, SATURDAY, MAY 16, 1908.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

INVESTIGATIONS FOR THE GATUN DAM.

With a view to ascertaining with absolute certainty the conditions at the site of the Gatun Dam, an elaborate investigation is now being carried on, the purpose of which, as outlined by Mr. Saville, the engineer in charge, is to determine the characteristics of the various soils and rocks which are to be used in the construction of the dam, the nature of the materials underlying the foundations, and the ground beneath the proposed embankments and walls. The most important experiment will be the construction of a section of a dam one-twelfth the size of the actual Gatun structure. This will be built in a water-tight wooden tank, into which the materials will be pumped, under conditions similar to those that will exist when the dam itself is built. The completed section will be subjected to water pressure for a considerable length of time, and records will be kept of the rate at which water percolates into the material. Horizontal pipes will lead from the interior of the dam section out through the side of the tank, where they will connect with glass gages. By this means the "slope of saturation" can be determined, and the slope of the dam arranged so that no water can find its way through until it has lost all of its pressure. Various materials will be tested in the tank in order to determine which is the best to use in the great dam itself. Another set of experiments consists in placing a layer of material in a tank, 3 feet in diameter and 5 feet high, and exposing it to a constant head of water. By means of glass gages a determination will be made of the amount of water that passes through under various heads, and in this way it will be known what thickness of the particular material under test will be sufficient to make the embankment practically impervious. Studies are also being made of the landslides along the Isthmus, the friction angle and coefficient of friction for various materials being determined by means of large sliding boxes. Upon Gatun Island a huge exploration pit 20 feet square is being carried down to a depth of at least 100 feet. Samples of the material at every 10 feet of depth will be subjected to mechanical and filtration tests to determine its behavior. To ascertain the action of the material under heavy water pressure, cylinders of the soil and rock are placed in strong iron tubes and subjeeted to water pressures varying from 20 pounds to 80 pounds per square inch. Also tests are being made of the several rocks encountered, to determine their resistance to abrasion and to the eroding action under pressure. Wash-drill and diamond-drill investigations are being carried on upon a more extensive scale than before. In the words of the Canal Record, "The ground is being so thoroughly explored, and to such great depth, that it is felt that no conditions can obtain which will materially change the plans after they have once been decided upon."

TO SECURE BETTER RAILS.

The agitation of last year against the poor quality of rails turned out by the rail mills is bearing good fruit. More than one organization has been investigating the subject of rail manufacture, in the endeavor to frame new specifications designed to secure a rail that will stand up faithfully to its work. Perhaps the most important of these is the committee of the American Railway Association on "Standard Rail and Wheel Sections," whose report presented at the New York meeting of April last is now before us.

It will be remembered that in the series of articles which we published some twelve months ago, it was shown that the most serious point of controversy between the railways and the rail mills was the question of "discard," or the amount of the ingot which should be rejected, before the latter was passed through the rolls. The railways were in favor of a discard of from 25 to 30 per cent of the top of the ingot. The rail mills, on the other hand, had reduced the discard, until in the current practice, it was not more than 8 or 10 per cent, and sometimes even less. The object of rejecting such a large percentage as 25, was to get rid of the segregated material and of the pipes or cavities which develop with more or less seriousness during the cooling of the ingot. Now, in the investigation of the American Railway Association, the committee decided that it would be preferable to aim at securing perfect rails rather by testing the finished rail than by making any close specifications as to the way in which the rails should be manufactured in the mills. It was decided that the best results would be obtained by abolishing the discard altogether, and basing rejections of the rails upon the results of tests made upon rails rolled from the upper portion of the ingot. To determine the practicability of this method, a trial lot of rails was rolled from the ingot without any discard, and the rails were then tested to destruction and the fracture examined. This test proved to the satisfaction of the committee that if "pipes" or other physical defects were present, they could be detected; and the committee was satisfied that rail manufacture could be so conducted that physical defects of any kind whatsoever would be reduced to a minimum. It will be remembered that the committee of the Pennsylvania Railroad, as was mentioned recently in this journal, following the same idea, drew up a specification which provided that whenever physical defects were discovered, all top rails of the heat should be rejected. This would mean a discard of between 25 and 30 per cent of the entire metal in the heat, should physical defects be found; and it was realized that a requirement of this kind would at once secure the rejection of defective rails, and insure the practice of very careful manufacture on the part of the rail mills.

The question of segregation was carefully considered by the committee, and it was agreed that if all segregated metal must be rejected it would be necessary to discard more than a third of the upper part of the ingot. Furthermore, the analyses of rails that had been many years in service indicated that a wide variation in chemical composition due to segregation may occur wthout affecting the safety or wearing quality of the rail. None of the experts consulted was ready to say what the limit of this variation might safely be, and the committee state that they will be unable to determine definitely the effect of segregation until after they had opportunity to observe the results obtained with rails rolled under the new specifications eliminating rails containing physical defects.

The committee are convinced that with regard to the question of phosphorus, it will be impossible for the mills to furnish more than a small percentage of the total rails required if they are made under the Bessemer process, with a phosphorus specification of less than 0.10. Railroads desiring to obtain low-phosphorus rails are reminded that they have the option of using open-hearth steel. The specifications lay down very detailed instructions as to the process of manufacture and testing, and, except for the chemical composition, these specifications apply both for the Bessemer and open-hearth process. The chemical composition of open-hearth steel rails, weighing 100 pounds to the yard, calls for the following percentages: Carbon, 0.70 to 0.80; manganese, 0.75 to 1.00; silicon, 0.10 to 0.20; phosphorus, not to exceed 0.04; and sulphur, not to exceed 0.06. For Bessemer-steel rails the chemical composition is: Carbon, 0.46 to 0.56; manganese, 0.90 to 1.20; silicon, 0.10 to 0.20; phosphorus, not to exceed 0.10; and sulphur, not to exceed 0.075. In these specifications the committee consider that the nearest approach to a satisfactory single standard type of rail has been arrived at consistent with present engineering knowledge and opinion. Provision has been made for the rejection of all rails containing dangerous physical defects; and the adoption of new and better balanced sections will enable the manufacturers to roll the rails at lower temperatures, thus insuring a finer grain and better wearing quality, as well as reducing the internal stresses.

A HEAT FLYWHEEL.

A highly successful example of the utilization of the exhaust steam from a reciprocating engine is to be found at the Wisconsin Steel Company's mill at South Chicago, where the exhaust from a large blooming mill engine is used to drive a steam turbine. The average indicated horse-power of the engine is 1,010, with a consumption of steam of 54 pounds per horse-power per hour. The most interesting part of this plant is a regenerator, or accumulator, which absorbs the energy of the exhaust steam and gives it up to the turbine as it is required. In the course of a paper on this remarkable plant, presented by Henry H. Wait before the American Institute of Electrical Engineers, this accumulator was very aptly described as a heat flywheel.

The exhaust from the engine first passes through a receiver, provided with baffle plates, which deadens the puffs and equalizes the flow. It then passes to the accumulator, through a series of finely-perforated pipes, through which the steam is [illegible]d into the body of water in the accumulato. More or less of this steam is condensed, and gives up its heat. The steam enters the accumulator, which is operated at about atmospheric pressure, at about 212 deg. Fahr., and tends to heat the water to the same temperature. From the accumulator the steam is led to a turbine of the Rateau type. Should the blooming-mill engine stop running and the flow of exhaust steam be discontinued, there will be present in the accumulator a mass of water at 212 deg. Fahr.; and if the turbine is running under a continuous load, the flow of steam will reduce the pressure. The water will then boil under the lower pressure, and give off steam at about the atmospheric pressure. If the blooming-mill engine starts up again, the exhaust steam will enter the accumulator at a temperature slightly above that to which the water has fallen on account of the cooling due to the evaporation of the steam drawn off for the turbine, and the whole mass of water will again begin to rise in temperature. To provide for any lengthy stoppage of the reciprocating engine, an automatic reducing valve connected to the steam boilers is so set that it will open whenever the pressure falls below the atmosphere, and deliver live steam to the regenerator.

The practical results obtained by this installation are highly gratifying. It became possible for the mill to shut down two 250-kilowatt engine-driven generators which formerly operated the mill, and for a considerable time the turbine plant took care of the entire electrical load of the mill, utilizing only the exhaust of the blooming engine, and using live steam from the boilers only when the blooming engine was shut down for an abnormal length of time. The installation has resulted in saving the amount of coal necessary to generate the steam for[illegible]y required for running the generator engines, a saving estimated at from $10,000 to $20,000 a year. Tests of two hours' duration of the exhaust-steam turbine showed that the average pressure under the controlling valve was 24.85 pounds; the average vacuum at the exhaust casing, 26.40 pounds; the average consumption of steam per brake horse-power per hour at the turbine was 33.7 pounds; and the average brake horse-power at the turbine shaft was 869. Finally, the total cost of the plant, including oil, attendance, maintenance, and fixed charges, was 0.299 cent per kilowatt hour; these figures being based on a delivery of 51 per cent of the total possible kilowatt hours of the turbine, if it had been operated at its rated load during the three months steam plant was running at nearly full cap[illegible]

FORMER CHIEF ENGINEER STEVENS ON THE CANAL.

It will be remembered that Mr. John F. Ste[illegible] former Chief Engineer of the Panama Canal, wa[illegible]ported in the daily press as having a few weeks[illegible] delivered an address at New Haven, in which he made certain drastic criticisms of this great work. We are glad to note, however, that extracts from a full copy of his paper, recently published in an esteemed contemporary, show that the press reports were entirely unjustified. What he said was confined largely to an account of the difficult work of organization which confronted him, and occupied practically all his attention while he remained on the Isthmus. This work consisted in the reconstruction of the Panama Railroad, which was absolutely essential before the enormous yardage of excavation to be done could possibly be handled, and the gathering together and making provision for the great number of skilled and unskilled laborers and clerical and supervising forces requisite to carry on the work.

Mr. Stevens makes no criticism of the general plans of the canal; and it is well worthy of note that he went to the Isthmus inclined to favor a sea-level canal, but after making a personal study of the conditions, abandoned it in favor of the high-level, lock canal now being built. During his term of office, he recommended the construction of locks at Miraflores and Pedro Miguel, instead of at La Boca—a change which has recently been approved. Two hundred millions of dollars, in addition to the money already paid to the French company and to the Republic of Panama, should complete the work as planned originally, though, because of changes since made in the locks, the cost must now be greater. It is Mr. Stevens's opinion that after allowing proper time for contingencies, the canal should be in active operation in seven years from the present time.

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METCHNIKOFF'S THEORY OF LONGEVITY.

A great many endeavors have been made to fix the duration of human life, and of animal life in general, within limits prescribed by a definite law. The fact that large animals live longer than smaller ones has been made the basis of the statement that the total duration of life is proportional to the time required to reach maturity, since the duration of the period of development of an animal usually varies with its size. This relation is not a simple one, however, for the horse, entirely adult at four years, lives to forty years of age in many cases. The sheep, on the other hand, not fully developed until its fifth year, is quite senile at fourteen.

The period of gestation, also, has been taken as the main factor for the computation of length of life. Too many exceptions are present in this case to make the deduced conclusions reliable. The horse, again an instance, passes through a longer period of embryonic life than does man, yet it does not live more than half as long. Sex apparently has nothing to do with the case, for men and women both seem to have about the same extent of life.

Among the invertebrates, great ages are sometimes reached. Sea anemones have frequently been kept in captivity for over sixty years. Some marine bivalves (*Tridacna gigas*) live to sixty or a hundred years.

In spite of the variability of the life periods of insects, some reach truly great ages, comparatively speaking. Our American seventeen-year locust (*Cicada septemdecim*) lives in the larval stage alone, as the name implies, seventeen years.

Reptiles like the tortoise and the crocodile are very long-lived also. Crocodiles have been kept in the Paris Museum of Natural History for more than forty years without showing signs of senescence. In the garden of the Governor of Cape Town, a tortoise has lived for eighty years, and is believed to have reached the two-hundred-year mark. Another, a native of the Galapagos Islands, is known to be 175 years old. The natural inference is that in cold-blooded animals the changes of metabolism are so slow that the organism is not as rapidly altered as in the warm-blooded forms. The truth of this statement has yet to be proved.

The commoner life of birds is for from 15 to 20 years. Canaries have lived in captivity for from 19 to 20 years; gold finches, up to 23 years. Parrots often reach 80 years, and not infrequently a hundred. A raven is known to have reached 69 years, and another 50. In the royal park at Schönbrun, near Vienna, a white-headed vulture died at 118 years, and a golden eagle at 104.

Going up the scale of development, we find that life is still shorter among the mammals. Elephants seldom live over 100 years. The number of years lived by sheep and by horses we have mentioned before.

Upon inquiring into the causes of these variations in duration of life, Metchnikoff finds the key in the digestive system. The organs of respiration, circulation, and of urinary excretion show no great differences in the various forms of creation. When, however, we reach the digestive tract, the whole aspect changes. This is most markedly shown in birds, for in the various species, the greatest differences in length of life and in the composition of the digestive tract are found.

As spoken of before, parrots are very long-lived. They have a very simple alimentary canal, and a very small number of intestinal microbes, owing to the short time that matter remains in the intestine. Astriclus and other cursory birds, provided with a well-developed cæcum, show profuse and varied intestinal flora. They approach the short-lived mammals in length of life. If length of life is due to freedom from intestinal microbes, a preventive of bacterial life must be found. This, according to Metchnikoff, seems to exist in lactic acid.

That lactic acid is a preservative is a time-honored fact. Meat is often preserved in sour milk. Milk itself undergoes lactic fermentation, but it decomposes only under the conditions most propitious for decomposition to take place. Sauerkraut is the product of lactic acid fermentation, and owes its keeping qualities to this substance. The races living upon the various preparations of sour milk are usually found to attain remarkable ages. Cases, both individual and collective, of great age in those living on a diet of curdled milk are almost too numerous to mention. A few, however, may prove instructive. Metchnikoff gives an account of one Riley, who was shipwrecked on the western coast of Africa, and was enslaved by Arabs. He says members of the tribes with whom he came in contact were two or three hundred years old. That these figures are too high is only too probable, nor can they be taken as more than indications, yet they are not without interest, since these Arabs lived upon camel's milk, fresh or soured.

In Bulgaria there is a surprising number of centenarians; the staple food in Bulgaria is *yahourth*, a soured milk. A laborer of Verdun, Ambroise Jaulet by name, died in 1751 at the age of 111 years. He "ate nothing but unleavened bread, and drank nothing but skimmed milk."

Curdled milk and other similar milk products are the result of the action of lactic-acid bacilli, which produce lactic acid at the expense of milk sugar. In most of these soured milks there are too many different kinds of microbes, often pernicious, associated with the bacillus actually causing the desired fermentation. Therefore it is best to procure some form of ferment which is known to be pure. The preparations of the Bulgarian bacillus are the best for this purpose, according to Metchnikoff.

The Bulgarian bacillus was isolated from yahourth by M. Massol. It produces lactic acid in large quantities, while very small quantities of other acids, such as acetic and formic, which are somewhat injurious, are formed.

The method of preparing soured milk advocated by M. Metchnikoff is as follows: "After the milk has been boiled and rapidly cooled, pure cultures of the lactic microbes are sown in it in sufficient quantities to prevent the germination of spores already in the milk and not destroyed by the boiling. The fermentation lasts a number of hours, varying according to the temperature, and finally produces a sour curdled milk, pleasant to the taste, and active in preventing intestinal putrefaction. This milk, taken daily in quantities of from 300 to 500 cubic centimeters, controls the action of the intestine, and stimulates the kidneys favorably."

The bacilli may also be taken dry as small pellets, but a goodly quantity of sugar-containing material, such as jam or the like, must be taken with each tablet, to furnish the necessary material from which the microbes can produce the lactic acid. Metchnikoff claims that he has been himself benefited by his treatment.

* The Prolongation of Life. Optimistic Studies by Elie Metchnikoff, sub-director of the Pasteur Institute, Paris. The English Translation by P. Chambers Mitchell, M.A., D.Sc. Oxon., Hon. LL.D., F.R.S. London, 1908. G. P. Putnam's Sons.

COPPER-CLAD STEEL.

By a curious anomaly, steel is at once the strongest and the weakest of metals. Its frailty lies in the scant resistance which it is able to offer to corrosion, even when painted. By still another curious anomaly, copper is at once a weak and a strong metal. Its strength lies in its wonderful ability to resist corrosion. If it were possible to cover the corrodible steel with non-corrodible copper, a problem of vast technical importance would be solved.

Perhaps the most obvious way of utilizing the properties of copper is to deposit it on the steel electrolytically. But it has been found that between the two metals a film of moisture is impounded, which in time causes the steel to corrode and the copper to peel off. A French inventor then hit on the idea of drawing a copper tube over the steel. Still the moisture-filled space existed.

The latest solution, and apparently a successful one, is offered by J. Ferreol Monnot. Instead of drawing one metal over the other, he welds the two together. Broadly stated, his process consists in thoroughly cleaning a base or core of the steel; bringing it up to a welding temperature without permitting access of air and consequent oxidation during heating; contacting with it on the cleaned surfaces a highly-heated, or "supermolten," mass of molten copper; segregating from the mass in immediate proximity to the base a layer of the thickness desired in the subsequent compound ingot; allowing the base and coating layer to cool under or during compression; and drawing the compound ingot so formed to produce the drawn wire desired. The steel core or base used may be an ingot, bar, bloom, billet or other commercial form, and may be of any desired cross-section, as round, square, oval, etc., and of any size.

If the billet is to be made into structural steel wire or rods, where resistance to the corrosion of the elements is alone desired, the copper coating can be very light, indeed as low as ten per cent, by volume, of the steel. If, however, the wire is to be used for the transmission of electric current, the coating is made heavier, in order that it may present less resistance to the current. Hence 30 per cent, 40 per cent, and 50 per cent of the conductivity of a copper wire of the same size is produced, with consequent great increase of tensile strength, because of the presence of the steel. When the billet leaves the coating department, it passes through mammoth steel rolls, where the diameter is brought down to a final size of ⅜ inch and consequent length. These rolls of wire are then sent into the drawing department, where wire as small as a hair can be turned out. Most wonderful of all, the copper remains on the steel in the same proportion originally found in the billet. The same rolling mills and drawing dies that handle steel alone are used.

The next step will naturally be the adaptation of the process on a larger scale, for the covering of the immense steel girders used in our modern office buildings and other structures.

Copper-clad wire can be made into any kind of standard or twisted cable for ship rigging, catenary suspension, and the like.

When steel is drawn or made into springs, necessarily when hot, a resultant scale of iron oxide materially reduces its strength. Copper-clad metal cannot oxidize thus, because the steel does not come into contact with the air.

Shells or cartridges are not loaded in time of peace in any quantity, because of the deleterious action of brass and smokeless powder upon each other. Brass is used because it provides more strength than copper, which has no such effect.

MACHINE FOR MAKING WINDOW GLASS.

Readers of this journal will doubtless remember an article published in these columns in the issue of December 1, 1906, describing a new machine invented by Irving W. Colburn, Franklin, Pa., for the making of window glass. The machine in question is the first of its kind which has ever been successfully introduced for the commercial manufacture of window glass. It draws a continuous sheet of glass 42 inches in width (although there is no limit of the width) at a linear speed of 56 inches a minute for single strength, and 48 inches a minute for double strength. This it does without the assistance of the gatherers, blowers, snappers, and flatteners usually employed in glass plants. The only skilled men employed are the cutters and the superintendent. The cutters will some day give way to automatic devices. With three men and six boys more glass and better glass can be made by the machine than by thirty-nine men with the cylinder process. At present the plant is running twenty-four hours a day, three shifts of eight hours each.

In the article mentioned only that portion of the machine was described which is actually concerned in the process of drawing the sheet from a pot of molten metal. The subsequent stages through which it passes were not discussed because at that time the machine, although in full operation, was still unprotected by patents, and could not be described in its entirety. Those of our readers who were interested in our previous article will find in the current SUPPLEMENT a complete illustrated description of the machine in which the mechanical process for drawing glass into a sheet and for conveying it through the lehr to the cutting table is fully discussed.

THE CURRENT SUPPLEMENT.

The current SUPPLEMENT, No. 1689, contains among many interesting articles, papers on "Malleable Castings made by Melting Wrought Scrap in the Crucible and in the Open-Hearth Furnace," "Washing and Coking Tests of Coal," and "Machine for Drawing Window Glass Continuously in Any Width." Prof. Watson's treatise on the elements of electrical engineering passes to its seventeenth installment, in which transformers and transformer systems are discussed. Practical problems involved in the Edison concrete house are presented by Percy H. Wilson. E. L. Elliott tells something of the magnitude of the lighting industries. Prof. O. N. Witt discourses instructively on gases and vapors. The life of a radioactive element is presented by A. T. Cameron. Flying-machine inventors will read with interest an article on the Cornu helicopter, in which article very complete information is given about this novel machine. The third installment of Dr. Everette's paper on the formation of mineral veins appears.

MOTORS FOR VITICULTURE.

The application of motors for agricultural purposes, and especially for viticulture, is attracting considerable attention in Europe. In view of this fact, the international competition for motor machinery for viticulture to be held at Palermo, Italy, the coming autumn is interesting. A royal decree sets forth that the machine adjudged the best will be awarded the diploma and about $2,000, and that the minister of agriculture will purchase two of this class. The second prize consists of a gold medal and about $600. Application for admission must be sent to the minister of agriculture at Rome not later than August 15, and the machines or apparatus must reach Palermo by the 16th of October.

THE WRIGHT AEROPLANE EXPERIMENTS.

Although we have been unable to authenticate the 2-mile flight of the Wright brothers' new aeroplane noted in our last issue, nevertheless these two secretive gentlemen are apparently experimenting with success at their old camping ground near Kitty Hawk, on the coast of North Carolina. According to the newspaper dispatches, they are making short flights almost daily for the purpose of testing a new steering device, and they expect shortly to make a long-distance flight along the coast. On the 8th instant the longest of ten flights made is reported to have been about 1½ miles in about 2 minutes. The engine of the aeroplane is said to be a 4-cylinder French water-cooled motor of 30 horse-power, weighing 150 pounds.

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THE "CATERPILLAR" TRACTOR.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

For some months past the British military authorities have been experimenting with a new type of tractor for the haulage of heavy vehicles over rough and unstable ground. This machine represents a new development in traction. Briefly, its object is to crawl over the ground, there being a series of feet disposed along the periphery of two heavy side chains passing over fore and aft wheels. As this chain revolves, the feet are successively brought into contact with the ground, thereby impelling the machine forward or backward. Because of its peculiar movement, the soldiers at the Aldershot military center, where it is in operation, promptly christened it the "caterpillar."

General View of the 30 to 35-Horse-Power Caterpillar Motor.

The Tractor About to Descend a Sand Bank with a 5-Ton Trailer.

The engine is the invention of Mr. David Roberts, M.I.M.E., to whose courtesy we are indebted for the information contained in this article and accompanying illustrations. It was evolved as a result of the difficulties encountered in transport operations during the South African war, where the heavy guns could be hauled only by powerful traction engines, but the movements of which were hampered by the absence of suitable roads. Much of the country in which the military operations were conducted was either rough and broken or sandy. The wheels of the traction engines sank up to their axles, and were only extricated with difficulty. Numerous gullies and torrents also constituted a severe obstacle to progress. In view of this limited radius of action possible with traction engines of the ordinary type, the military department encouraged the evolution of a new design of tractor, to which rugged configuration of the ground or unstable earth would offer no impediment. The present apparatus is the outcome of this investigation, and it has proved remarkably successful, hills, banks, marshy, sandy and rough soil, ditches, and other obstacles being negotiated with equal facility and at fair speed.

The engine acquired by the War Office develops about 40 horse-power. The motor is of the Hornsby double-cylinder internal-combustion heavy-oil type. The military engineers submitted the chain tractor to a prolonged series of heavy trials in the sandy and swampy stretches in the vicinity of the Aldershot camp, the results of which exceeded anticipations. Owing to the success of these experiments, the inventors built a second oil-engine-propelled tractor, developing some 20 horse-power, and in order to demonstrate the capabilities of the gasoline motor in the same field, constructed a 30 to 35 horse-power motor car with trailer. The latter two, though of less horse-power than that constructed for the War Office, present the same features and perform the same remarkable achievements as the more powerfully equipped engine now in use at Aldershot for the haulage of heavy field guns, baggage, and general military stores.

The design of the engine is disclosed in the accompanying illustrations. An endless chain travels around driving wheels of substantial steel construction and provided with teeth on their periphery so as to form enlarged sprockets. The chain track is provided on its outer surface with a number of feet shod with rubber or wooden treads tied together with intermediate locking links, which render the bottom portion of the chain rigid, so as to form an arc with a radius of about 19 feet. The links which render the chain rigid when pressure is exerted from the outside make it flexible on the inside, so that it bends around the two sprocket wheels situated at either end of the arc. The rear one of these is the driver, which, the sprockets being engaged on the links, propels the engine by pulling at the chain, the latter being held to the ground by the weight, while the weight-carrying wheels pass over the inside track. The upper part of the chain pulled over by the driving wheel moves forward, and is guided by the front sprocket wheel to form a fresh and endless track. The weight of the tractor being carried on the long curved inverted arch of the chain, the pressure on the ground varies with its condition; and while on hard roads the pressure is less than with ordinary wheels, on soft ground the weight is so distributed that it can travel with safety where draft animals may not venture. The grip on the ground is vastly greater than it is with ordinary wheels, so that great loads can be hauled over ground which has hitherto been impassable. The chain track has a radius which is equal to a wheel 38 feet in diameter.

When it is required to turn, one of the chains is braked hard and the other allowed to travel.

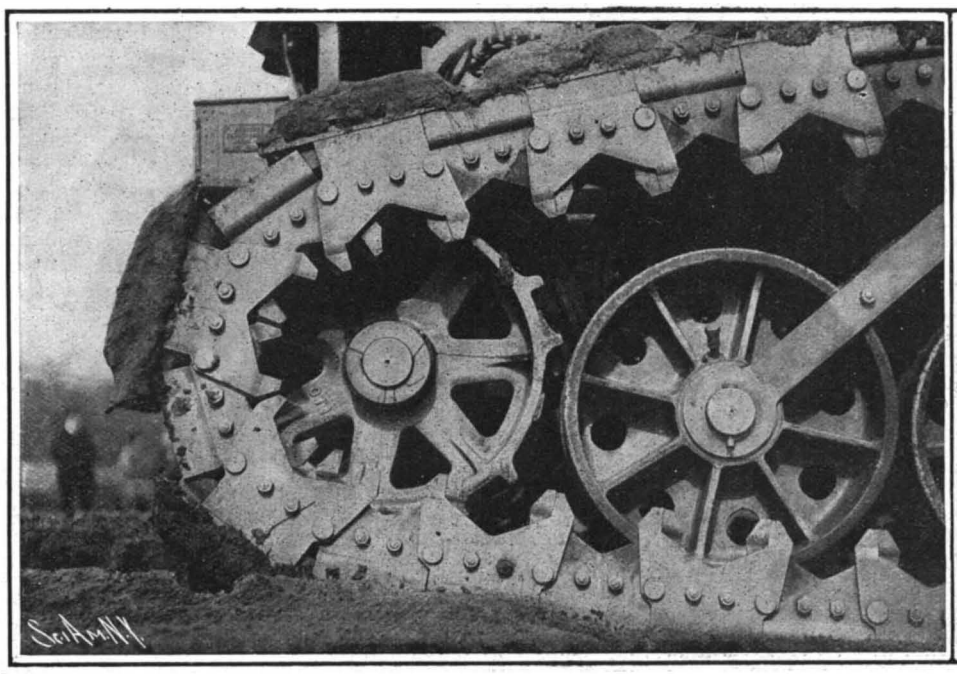
In the gasoline tractor the whole weight of the vehicle is supported and balanced on the two inner wheels, midway between the end wheels and engaging with the inner lower surface of the chain, there being two such wheels on either side. The small wheel mounted above these simply takes the weight of the upper part of the chain. In the larger oil tractor built for the War Office three wheels are disposed on either side to fulfill this end, but we understand that the first-named arrangement has proved more satisfactory, and will be adopted in all future vehicles.

Steering is effected by a wheel mounted in the usual manner, the rotation of which in either direction operates the brakes controlling the movement of the chains. For instance, if it is desired to turn to the right, the steering wheel is revolved in that direction as usual, and in so doing applies the brake to the right-hand side of the compensating gear, the radius of the turn varying with the pressure exerted by the brake. It will thus be seen that steering is perfectly simple and effective, and should the vehicle be caught in unusually difficult ground, it can easily extricate itself by a slewing or worming action with the steering gear.

Owing to the increased area of the surface brought to bear upon the ground, not only is the weight distributed over a larger area, but an increased adhesion surface is secured. Consequently, even when passing over the softest soil, it does not sink to any depth, while at the same time, even upon loose or slippery surfaces, a firm purchase can be obtained without the slightest tendency to slip or skid.

The experiments conducted with the vehicles have

(*Concluded on page 351.*)



Detail Showing Design of Feet with Interlocking Links.

Climbing a Clay Bank.

A CURIOUS MODE OF PROPULSION.

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RANGE AND POSITION FINDERS FOR COAST ARTILLERY FIRE CONTROL.

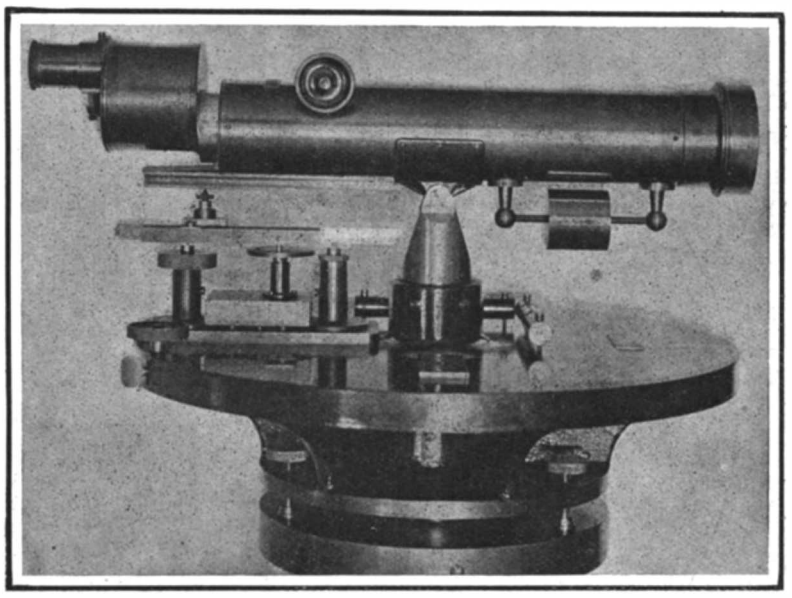
With the near approach to completion of the comprehensive system of artillery defense of the harbors of the United States recommended by the Endicott Board in 1886, the question of an efficient administrative and tactical control of the fire from the various gun and mortar batteries has become one of vital interest. The building of gun emplacements with their defensive parapets, magazines, etc.; the mounting of guns and mortars on modern carriages; the installation of electrical power plants for lighting, manipulating the guns, and for ammunition service—these are but the preliminary steps toward effective harbor defense. Position-finding service must be provided, powerful searchlights installed to sweep the water approaches at night, mine defenses laid down, elaborate means of communication between the various defensive units installed, and land defenses provided to protect the fixed armament from possible capture by landing parties operating from the rear.

In addition to this material equipment, it is necessary to maintain a force of trained artillerists, and because of the highly technical character of the duties of the artillery soldier, picked and carefully trained men alone are suitable for the work. The duties require special mechanical and electrical knowledge on the part of the men, and since the pay is relatively small compared with that obtained for similar work in civil life, it is not surprising that the War Department finds it difficult to maintain our coast artillery garrison at full strength.

Artillery fire control, as developed in our coast defenses, is the result of an elaborate series of experiments covering the past eighteen years and recorded in the reports of the Board of Ordnance and Fortifications during this period. The fundamental basis of every modern system of artillery fire control is the range-and-position-finding service. This is due to the fact that with the high initial velocities, flat trajectories, and long ranges of modern high-power guns, the use of an accurate instrument for quickly and automatically determining the exact position of the target at the moment of firing, has become an absolute necessity.

In the case of a moving target (the real war target is always in motion) the time element has first consideration, and this for the reason that the delay of a second or two in firing will often mean the loss of a shot. In one second of time, a moving warship may change its range five, ten, or even fifteen yards, according to its speed, with a corresponding change in its direction from the gun. The old-fashioned method of finding the range, by firing several trial shots, is now out of the question with any except machine guns and rapid-fire guns of the smaller calibers. The method is prohibitively costly, since the money value of the ammunition expended in finding a single range may equal the first cost of a range finder; while the latter is more accurate and far more durable than the gun itself and is always available when the battery is in service.

The distinction between range finders and position finders should be clearly understood. The former are more simple in construction and less expensive; but since they find ranges only, and must be used for direct laying at or very near the gun, or in conjunction with a more or less complicated system of calculations and replotting, they are seldom used as independent instruments. Position finders determine both the range and the direction of the target, the direction being usually expressed in degrees and hundreds of a degree of azimuth, or the horizontal angular distance of the object from the meridian. These instruments may be located at the battery, or at very considerable distances from the battery, and in either case they may be used equally well for direct or indirect laying of the gun. Two general classes of position finders are in use for coast defense, namely:



The Lewis Depression Position Finder.

1. Depression position finders, in which the working base is vertical and comparatively short, being the height of the axis of the instrument above sea level at the moment of taking an observation.

2. Horizontal base position finders, in which the working base is the comparatively long distance between two instrumental stations in which only horizontal angles are measured.

With instruments of the second class, the base end stations must be in reliable electrical communication with each other and with a third, known as the replotting station. A much larger number of operators and more time are necessary than with depression instruments. On account of the number of stations and operators required; the difficulties experienced in promptly identifying the target; the length and complexities of the lines of communication, and their unreliability for work at night; horizontal base position finders are used, if at all, only in connection with the depression instrument, or where the height of the battery and surrounding fortifications is too low to afford proper elevation for mounting an instrument of the depressive type. The theory of the depression position finder, as illustrated in the accompanying sketch of a mortar battery, is based upon the properties of the triangle, by which if two angles and the contained side be known, the length of the other two sides may be calculated. The position finder is mounted on an elevation of known height above sea level, and the angle at the instrument is found by directing the telescope upon the distant ship. The vertical height above sea level representing one side of the triangle is known, and the angle formed by the vertical and the horizontal line to the ship at sea level is ninety degres. These data, modified by proper corrections, as given below, enable the other sides of the triangle to be computed, thus giving the exact range or distance of the ship. The most serious difficulties to be overcome in the production of a depression position finder sufficiently accurate for coast artillery use are the following:

1. The short vertical base of triangulation (the height above sea level of the horizontal axis of the telescope at the moment of observation) varies constantly with the rise and fall of the tide.

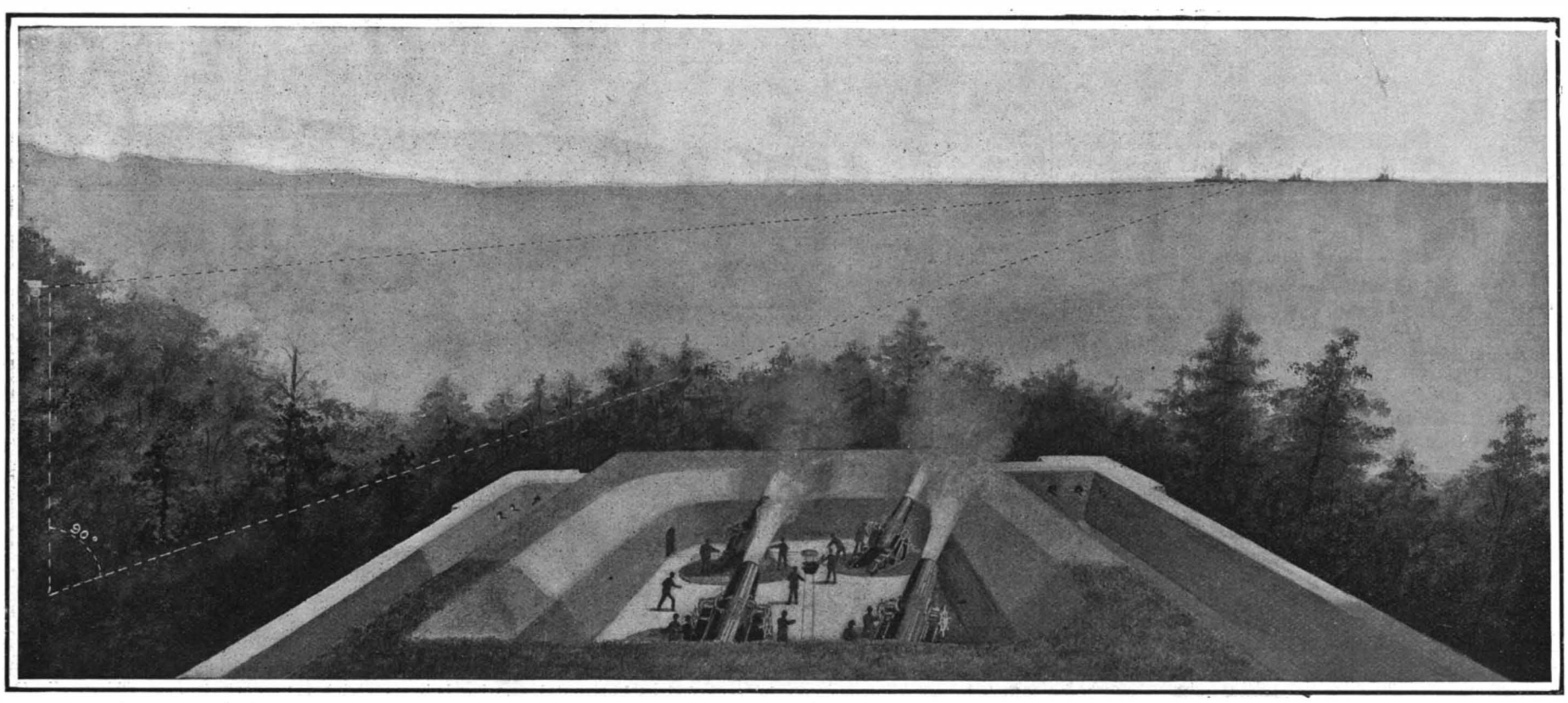
2. The ranges must be measured along the arc of a great circle, and the automatic triangulation work of the instrument must mechanically and automatically compensate for effects of the earth's curvature.

3. Atmospheric refraction, which continually varies in amount under the constantly changing conditions of the air with respect to heat, light, moisture, motion, etc., is often a serious disturbing factor, unless mechanical means are provided for quickly applying a proper correction.

4. Since the range is found by following the distant water line of the ship by means of a telescope, it is essential that this telescope be specially designed for the work.

The American government is indebted to Major I. N. Lewis of the Coast Artillery for the initiation and perfection of its depression position-finding service. The position finder known by his name, the first of its kind produced in this country, was developed by the inventor under the auspices of the Board of Ordnance and Fortifications between 1888 and 1896. It was officially adopted as the standard type for harbor defense in the latter year, and during the war with Spain a large number were purchased and installed. More recently other position finders, embodying numerous mechanical changes and improvements in the type, have been produced, and various models have been tested and adopted for use. The list now includes the Rafferty, the Warner & Swasey, the Whistler-Hearn, and the Bausch-Lomb-Seagmuller.

A few months ago the War Department conducted an exhaustive series of competitive trials of depression position finders at Fort Wadsworth, New York. The conditions of the tests were made to approximately simulate those of actual war. The official report of the Artillery Board giving the results of the tests is published in the January-February issue of the Journal of the United States Artillery. The observations, taken on fixed and moving targets, day and night,



The position finder is located in a masked position on some suitable elevation of known height above tide level. This height forms the base for calculating the triangle. The angle at the base is 90 degrees; and the angle at the instrument being observed, the distance to the ship is calculated. This is done automatically and instantly by the instrument.

BIRD'S EYE VIEW OF TYPICAL MORTAR BATTERY, WITH POSITION FINDER ON ADJOINING ELEVATION.

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under all conditions of weather and water, for a period of five weeks cover in all more than 50,000 separate range readings. No such exhaustive trials have ever before been undertaken in any service, and the results, as shown in the report referred to, are exceedingly gratifying, the Lewis depression finder being adopted as the standard for the Coast Artillery Service on the grounds of accuracy, simplicity of construction, ease of adjustment and operation, superiority of telescope, stability and permanency of adjustment, and adaptability to change of height. The results of observation, according to this report, show an average error of all ranges on this instrument of 24.4 yards as against 35.1, 38.9, and 55.8 yards for the three other competing instruments. The accompanying photograph shows the new model instrument completely assembled ready for use. It consists of a 500-pound cast-iron pedestal supporting a brass 20-inch table and all moving parts. The masonry or concrete foundation pier, 3 feet in diameter, is sufficient to hold the instrument accurately in azimuth adjustment. The range scale reads from 1,500 to 12,000 yards, and it is properly corrected for effects of earth curvature and normal atmospheric refraction, while an easily-applied thumb screw connection is provided to compensate for effects of abnormal refraction.

Structure of Hailstones.

BY CLEVELAND ABBE.

There are three plausible hypotheses as to the origin of the snowy ice at the center of a hailstone.

(a) The hailstone may have begun with the formation of a ball of snow, and the clear ice may be a deposit of cold water, frozen a few seconds later by the cold of the surrounding atmosphere. In this case the air that is mixed with the snowy ice at the center would be compressed by the freezing of the surrounding clear ice, and would be liberated as a bubble when the hailstone is melted under water.

(b) The nucleus of the hailstone may have been at first a large drop of water, containing dissolved air, which is forced out by the process of freezing, precisely like the bubbles of air that are seen in cakes of artificial ice. Cold water can dissolve an appreciable percentage of its volume of air, all of which is extruded when water freezes; a bubble of highly compressed air might thus be formed at the center of the hailstone. If such a hailstone be melted in cold water slowly, all of this air will be redissolved, and no bubble will be seen to rise to the surface. If the stone be dissolved in hot water rapidly, or especially if the stone be crushed forcibly and quickly under water, the air may escape as a bubble without having had time to be redissolved.

(c) A hailstone formed of pure water that has had no opportunity to absorb or dissolve air can be reduced to a temperature far below freezing, but will eventually suddenly turn to ice, at which moment its temperature will rise to 32 deg. F., and it will assume a crystalline structure, so as to resemble snow. Such a hailstone has, therefore, a snowy nucleus without any inclosed air, and on being melted under water will, of course, show no bubble. In fact, the central space is occupied, not by air, but by the vapor of water only, and as the pressure is very small, we may liken this to a partial vacuum.

All these three forms of hailstones, and other forms as yet unthought of, are possible; and if we could invent methods of distinguishing between these three kinds of hailstones, we should have a better knowledge of what goes on in the upper air during the formation of hail.

Those who have proper conveniences will find that the study of hailstones under polarized light gives additional information as to their crystalline structure, but has not as yet told us much about the process of formation.

As ice is a poor conductor of heat, it is worth while to make some effort to determine the temperature of the interior of a large hailstone. The external surface may safely be assumed to have the temperature of evaporation or the average wet-bulb temperature prevailing in the lower thousand feet of air through which the hail has rapidly fallen, but the center must be at a temperature more nearly corresponding to that at which the nucleus was formed. There is, therefore, a state of strain that should be revealed by polarized light. The average temperature of the whole hailstone may be easily and directly determined by allowing hail to melt within a calorimeter, where the heat consumed can be determined, and then the temperature be computed.—Monthly Review.

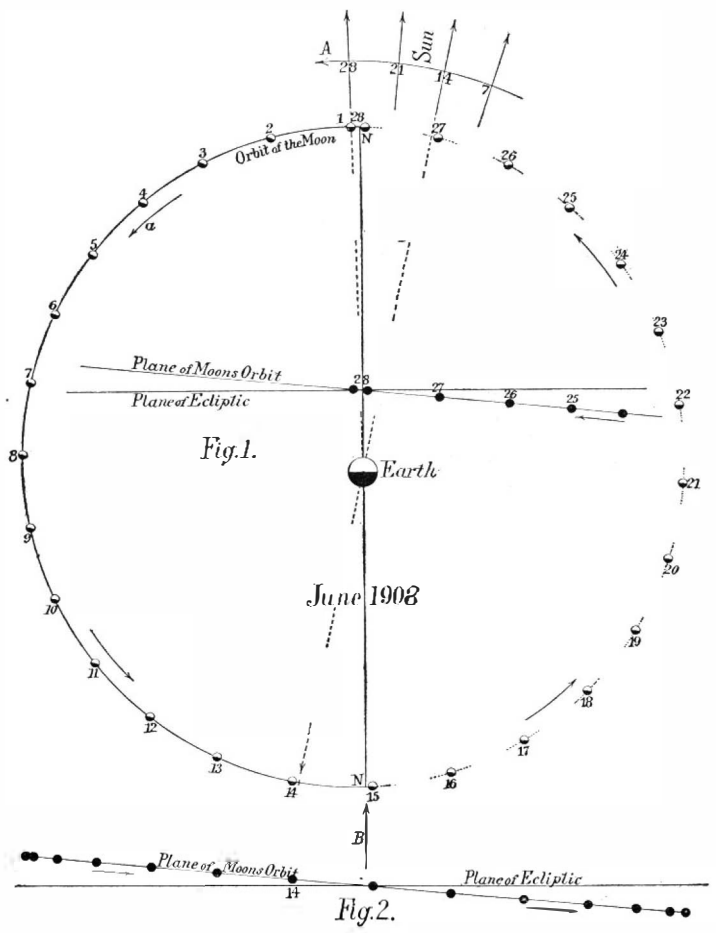
In Denmark only the inter-provincial, the inter-communal and the international telephones are worked by the state, while the local telephones are worked by private limited companies, under concessions.

THE ANNULAR ECLIPSE OF THE SUN IN JUNE, 1908.

BY PROF. FREDERIC R. HONEY, TRINITY COLLEGE.

During the year 1908 there are three solar eclipses. The first occurred on January 3, and was described by the writer in an article in the SCIENTIFIC AMERICAN for December 28, 1907. This eclipse was total, but the path of totality was wholly confined to the Pacific Ocean; and as a partial eclipse, it was visible from a very limited land area.

The accompanying figures illustrate the second eclipse, which will occur on June 28. During the interval of nearly six months, the earth will reach a point in its orbit nearly opposite that of January 3. Fig. 1



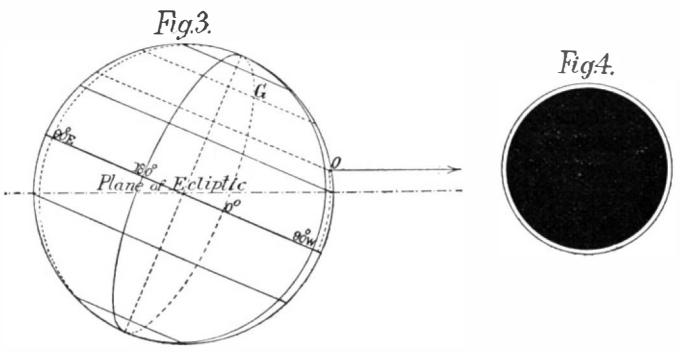
is a plot of the moon's orbit for the month of June, and may be compared with that of January. The orbit is here turned half way around, and presents a view looked at from a direction opposite to that of January 3. At the time of the eclipse of January 3 the moon was very near the descending node *N'*. On June 28 she will be near the ascending node *N*. As already explained, this page may be assumed to represent the plane of the ecliptic or the plane of the earth's orbit, which for convenience may be regarded as horizontal. That part of the moon's orbit for the first half of the month (represented by a full line) may be regarded as *above* the plane of the ecliptic; and the other half as *below* that plane. The position of the moon is shown for each day of the month from the 1st to the 28th at Greenwich noon; and the position of the moon's center is also repeated on the 14th, at the time of full moon nearly two hours later (14d. 1h. 55.2m.). The position of the moon is shown on the 28th at Greenwich noon, and also at the time of the central eclipse at noon (28d. 4h. 30.7m.). The direction in which the sun is seen is shown at intervals of seven days; on the 7th at noon; on the 14th at the time of full moon; on the 21st at noon; and on the 28th at the time of the eclipse. The positions of the sun and moon are here shown by their longitudes. As seen from the earth, they appear to move in the direction of the arrows *A* and *a*. If more than one eclipse occurs during an eclipse season, the interval between the eclipses is about two weeks, i.e., the time occupied by the moon in traversing about one-half of her orbit. On the 14th, the date of full moon, when an eclipse might be looked for, the moon will be too far above the plane of the ecliptic to come within the earth's shadow. (Fig. 2.)

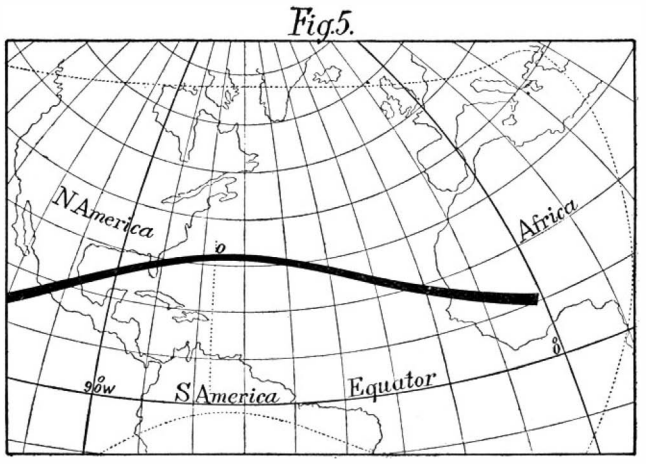
Fig. 3 represents the earth projected on a plane which is parallel to its axis, and perpendicular to the plane of the ecliptic. The meridians of Greenwich and those which are 90 deg. E. and W. are shown. The equator, the tropics, the polar circles, the parallel of Greenwich, and of 31 deg. 27.3 min. N. are also shown. The latter in longitude 66 deg. 55.3 min. W. is the position of an observer marked *O*, to whom the central eclipse will be visible at noon. In the figure the position of Greenwich (marked *G*) and of the point *O* are situated on the invisible hemisphere. The arrow indicates the direction in which the observer is looking. Since the sun is nearly four hundred times the distance between the earth and the moon, a line drawn to its center from the point *O* in the drawing, is nearly parallel to the plane of the ecliptic; and its distance from that plane does not differ very much from the distance between the moon's center and the plane of the ecliptic. Attention is called to the difference in the position of the observer during this eclipse from that occupied by him in the eclipse of January 3. In January the observer was *south* of the equator, and looking toward the right from Fig. 3. In June the line of vision will be in the opposite direction from a point *north* of the equator. In both cases the observer's position is *above* the plane of the ecliptic.

The moon at the time of the eclipse will be very near apogee, and will therefore subtend an angle which is a little in excess of the minimum angle subtended this year. Owing to the earth's nearness to aphelion, the sun will subtend an angle which also differs very little from the minimum. But the apparent diameter of the moon will be less than that of the sun. The moon's disk at the time of the eclipse will subtend an angle of 29 min. 58 sec.; and that of the sun, an angle of 31 min. 31.4 sec. The result will be a narrow annular area of the sun's disk around the dark body of the moon, as shown in Fig. 4.

Fig. 5 is a map of a portion of the earth's surface. The heavy line shows the path of the annular eclipse, in which is situated the point *O* corresponding to the position shown in Fig. 3. The dotted line incloses the land area from which a *partial* eclipse will be visible; the remaining area is limited to the Pacific Ocean.

The maximum width of the ring of light surrounding the moon in an annular eclipse, would evidently occur if the moon were at apogee and the earth at perihelion at the same time. The moon would subtend a minimum, and the sun a maximum angle. The maximum apparent diameter of the sun is 32 min. 35.7 sec.; and the minimum diameter of the moon this year is 29 min. 26.4 sec. If an annular eclipse occurred under these conditions, the width of the ring surrounding the moon's disk would be twice as great as that shown in Fig. 4. If Fig. 4 is held at a distance from the eye equal to one hundred and nine times the apparent diameter of the sun, here represented, it will subtend the same angle as that subtended by the sun at the time of the eclipse. A circle one inch in diameter placed at a distance of nine feet (= 108 inches) from the observer, subtends an angle which is equal to that subtended by the sun on April 26, when the apparent diameter is a little greater than that at the date of the eclipse.





PATH OF THE ANNULAR ECLIPSE.

The Börsen Courier, Berlin, learns that the German Admiralty is planning the erection of a new shipyard for repairs in connection with the projected drydocks at Brunsbüttel, on the Kiel Canal. The new yard will be employed only in case of need for the construction of small auxiliary vessels, its usefulness otherwise being restricted to dock traffic. Above all, the Admiralty wishes to have a body of trained workmen at the mouth of the canal, and to be sure of being able at any time to effect repairs at the exit of the canal at Holtenau.

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THE "CATERPILLAR" TRACTOR.

(*Concluded from page 348.*)

been especially severe. In one trial a lorry loaded with three tons was hauled by five horses into a swamp, where the vehicle sank to the axles, and from which position the horses failed to extricate it. By means of the tractor, however, the load was dragged out with ease. Similarly, a two-wheeled vehicle laden with 1.5 tons was hauled into the swamp by four horses, and, after sinking into the loose soil, it resisted the efforts of the animals to withdraw it, the horses themselves sinking to a depth of two feet under the powerful effort they exerted. In this instance similarly the vehicle was quickly drawn out by the chain tractor. In order to demonstrate the efficiency of the chain track system itself over the ordinary type of wheels, two horses were harnessed to the chain tractor, which represented a total weight of 3.75 tons, and with the engine gear disconnected to enable the chain to travel freely, it was easily hauled through the bog, neither the horses nor load showing any tendency to become stalled, while the imprint of the feet of the chain was only about two inches. Subsequently, the engine of the tractor was reconnected, and with a trailing load of five tons attached, the whole was driven through the swamp, and various maneuvers executed in the softest part without imposing the slightest strain upon the engine, thereby testifying to the value of the chain track system.

The engine also displayed its unique possibilities in the negotiation of obstacles in its path. When an ordinary wheel meets such an obstruction, it has to lift itself together with the whole of the superimposed weight. In the case of this tractor, however, the encountering of an obstacle simply gives a slight inclination to the chain track, which being raised forms a bridge for the weight gradually to surmount.

Ditches, gullies, or fords can easily be crossed therewith. The chain tractor moves on until it reaches its critical point, the front overhanging the ditch, when the forward feet move gently on the farther side, and the rigid chain track forms a bridge over which the engine travels. Ditches which, owing to width and depth, would be sufficient to bury the front steering or rear driving wheels of an ordinary traction engine, can be easily and safely passed over.

In the case of crumbling dry clay or soft slippery soil, owing to the extended surface of the chain track upon which the weight-carrying wheels rest, the tractor does not sink into the ground; while owing to its extended and greater adhesion surface giving enhanced purchase, considerable loads can be transported over soft clay and deserts, which would be impassable by other means.

The engine has also remarkable hill-climbing capabilities, no matter what the nature of the soil may be. In the tests a bank of soft clay 20 feet in height, which when measured gave a grade of 1 in 2, was mounted speedily and without effort. Even snow and ice offer no impediment to its progress, since it has hauled maximum loads up to the full power of the engine up hills of 1 in 10 covered with ice one inch in thickness without slipping or breaking the ice, and without any additional assistance in the way of spikes, sand, or gravel to give improved adhesion, the tractor simply relying upon the grip provided by the surfaces of its numerous feet.

For haulage purposes the manufacturers have evolved a special chain track for application to trailing vehicles, the utilization of which facilitates the operations of the tractor itself and enables high speeds to be maintained under the most difficult circumstances. Arrangements are being made whereby the system can be applied to gun carriages for field operations, the weight of which precludes their being hauled through treacherous ground by the general means in vogue. Efforts are also being made to simplify the system of animal traction by applying the principle to the wagon, since trials have shown that horses can haul vehicles thus equipped with far less exertion than the ordinary wheeled types.

For the heaviest haulage work in mountainous districts, such as the transport of a 4.7 or 6-inch naval gun, where the grade is in excess of 50 per cent the system adopted is as follows: The tractor first ascends the slope, paying out meanwhile a steel cable to which the trailing vehicle is attached. When the limit of the cable is reached, the tractor is chocked and the trailer hauled up behind by means of the winding drum on the tractor. The trailer is then chocked in turn, and the tractor sent ahead once more, chocked, and the trailer hauled up a second step, this cycle of operations being continued until the summit of the grade is attained.

The Railway Age states that 5,730 miles of new track was laid in the United States in 1907, being 8 per cent less than in the previous year. The States in which largest mileage was laid were Louisiana, 422 miles; South Dakota, 385 miles; Florida, 341 miles; Texas, 314 miles; and Washington, 311 miles.

Correspondence.

Audubon and His Snake Story.

To the Editor of the SCIENTIFIC AMERICAN:

Referring to the communication from Mr. George W. Colles in your issue of May 2, in reference to a former letter from Mr. W. N. Hutt on an alleged rattlesnake incident published by Audubon, it seems to me that the snake in question was much more probably a specimen of *Coluber obsoletus* or *Coluber guttatus* than a black snake. The largest specimens of the latter would have quite a time in swallowing an adult gray squirrel, and it would be a good square meal for the larger colubers even. Personally, also, I should consider *Coluber obsoletus* (our common chicken snake) more arboreal than the black snake, particularly when the greater rarity of the former in this section is considered.

No doubt Mr. Colles is correct in his supposition that Audubon simply made a mistake in his species.

Raleigh, N. C. H. H. BRIMLEY.

The Fourth Dimension Simply Explained.

To the Editor of the SCIENTIFIC AMERICAN:

Those readers who were interested in the above question, so clearly dealt with in your issue of March 21, may perhaps be also interested in certain principles considered in a pamphlet by the late C. C. Massey, which I hope will be published, and from which I have drawn. Consider a living being of some form existing in a universe of two dimensions. Then, for this being, there will be matter with the quality of resistance in two dimensions. For anything in this universe will occupy space of two dimensions, and so will exercise resistance against any other thing touching it.

Now consider a living being in our space of three dimensions. This being, as we know, lives in a universe of matter which has the necessary quality of resistance, and I think this being may be assumed to have a fuller and higher life in a fuller and higher universe than the universe of two dimensions.

But when this being of a universe of three-dimensional space considers a universe of two-dimensional space, it finds there is *no matter* and *no resistance* in the universe of two dimensions! In reality, the being of two-dimensional space does not exist in a universe of matter and resistance; it only experiences matter and resistance because it is limited to an existence in a universe of two-dimensional space!

In exactly the same way, a living being in a universe of four-dimensional space would *know* that our universe of three-dimensional space is not really one of matter and resistance, but one in which we *experience* matter and resistance, simply because we are limited to existence in three-dimensional space.

The above line of reasoning, if logical in the assumptions of the existence of other spaces than that known to ourselves, is still as pure reason as was Kant's in his "Critique"; and I do not think this reasoning is metaphysical.

But the reader will understand how, metaphysically, this reasoning leads us to a conclusion (with Kant) that our ideas of space (and time) are of space (and time) as *subjective* and not *objective*.

F. C. CONSTABLE, M.A., Trin.Coll.Cam.

Corlis Court, near Bristol.

Official Meteorological Summary, New York, N. Y., April, 1908.

Atmospheric pressure: Highest, 30.53; lowest, 29.28; mean, 29.93. Temperature: Highest, 79; date, 26th; lowest, 27; date, 5th; mean of warmest day, 68.5; date, 26th; coolest day, 31.5; date, 4th; mean of maximum for the month, 59; mean of minimum, 42.2; absolute mean, 50.6; normal, 48.6; excess compared with mean for this month for 38 years, +2.0. Warmest mean temperature of April, 53, in 1878. Coldest mean, 41, in 1874. Absolute maximum and minimum of this month for 38 years, 90 and 20. Average daily excess since January 1, +1.2. Precipitation: 1.82; greatest in 24 hours, 0.78; date, 30th; average of this month for 38 years, 3.33. Deficiency, —1.51. Accumulated deficiency since January 1, —1.74. Greatest April precipitation, 7.02, in 1874; least, 1.00, in 1881. Wind: Prevailing direction, N. W.; total movement, 11,279 miles; average hourly velocity, 15.7 miles; maximum velocity, 60 miles per hour. Weather: Clear days, 13; partly cloudy, 11; cloudy, 6; on which 0.01 inch, or more, of precipitation occurred, 10. Thunderstorms, 28th. Snow, trace, date 2d. Frost, light, 14th; heavy, 17th.

An Eighth Moon for Jupiter.

The staff of Greenwich Observatory announce that they have discovered an eighth satellite of Jupiter. During an examination of photographic plates of Jupiter, Mr. Melotte, one of the assistant astronomers, discovered a faint marking occupying slightly different positions on the different plates. The satellite has a retrograde motion.

A MAGAZINE FOR THE BLIND.

Undoubtedly the whitest printing plant in the world is that in which the Ziegler Magazine for the Blind is published. The reason is obvious. No type is used, and no ink of any description is to be found except, of course, in the editorial room where pen, pencil, scissors, and paste are as essential as in every well-ordered editorial sanctum. The printing plant claims to be the largest of its kind; for the monthly magazine it turns out contains fifty leaves or reading pages and has a circulation of about 8,000. The scope of the magazine is very broad. It gives a monthly review of current events, some standard literature, both prose and verse, short stories, a page of music, and a page of conundrums and jokes. The last two pages are especially popular. A keen sense of humor is to be found in all the blind, while the trained ear of a blind man appreciates good music and his nimble fingers readily learn to operate the strings or keys of a musical instrument. The magazine is endowed by Mrs. Matilda Ziegler, and except for a nominal subscription of 10 cents a year to bring it within the postal requirements, it is circulated without charge to any person in the United States or Canada who can read the point alphabet.

In the composing room of the plant there are two machines, one of which makes the plates for the New York point edition, while the other serves for the American Braille. Very unfortunately, both of these point alphabets are in general use in the country so that the magazine has to be published in two editions. The system of using raised Roman characters has been almost entirely displaced by the point systems because it is far easier to feel a combination of raised points than to sense the curves and angles of an embossed Roman letter. In the point systems each character is made up from one to six raised points variously arranged in two rows of three places. In the New York point, which is the easier system of the two, the rows are horizontal, while in the American Braille, a modification of the system developed by a blind Frenchman named Louis Braille, the rows are vertical.

The composing machines punch the point characters on a thin brass plate. The keyboard of the machine with its black and white keys looks like a small section of a piano keyboard. By depressing these keys in various combinations the proper punches are brought into active position and then, on working a treadle, the group of points is simultaneously indented in the brass plate to form a single character. When the representative of the SCIENTIFIC AMERICAN visited the composing room the operator was struggling with the accents, umlauts, and various pronunciation marks of a German-English dictionary for the blind. Imagine learning a foreign language by touch!

The back cover page of each number of the magazine is illustrated. Usually a map is shown and an illustration of some prominent structure, such as the Brooklyn Bridge, or the Statue of Liberty. In one of our engravings we illustrate one of the brass plates used for the back cover page. A translation of the point characters has been written on the plate for the benefit of our readers. These cover plates must all be made by hand. Music is written by using different combinations of points for notes of different time value. No lines are used, so that to the ordinary seeing person a page of music looks no different from an ordinary reading page of the magazine.

The page plates of the magazine are read by a blind proofreader, because the blind can more readily detect errors than could a seeing person. Errors are noted by underscoring. The points are then obliterated by hammering them flat, after which the correct letter or word is punched in.

The printing is done on a new type of press, especially built for the Ziegler Magazine, and it has a capacity of ten thousand pages per hour. It will turn out in a day as much work as 320 men and 140 machines could do by the old interpointing process now in use in England. A single month's edition of the Ziegler Magazine, if printed by the interpointing process, would keep two men and one machine busy for two years. The new press is of a rotary type, comprising a pair of rollers. The brass plates are secured to one of the rollers and bear against a rubber blanket on the other roller. The paper is fed between the rollers and is indented by the raised points on the plate. The paper is moistened before being run through the press and after receiving the impression it must be dried. If the printing were done on dry paper the point characters would be flattened down very quickly by the pressure of the fingers in reading. About 400,000 pages a month must be moistened, printed, and then spread out carefully to dry. Instead of the universal method of moistening paper by dipping each sheet separately, a sprinkling device is used with which the sheets may be thoroughly moistened in bulk, thus effecting a great saving in time and labor. At present the printing is done on only one side of the paper, but it is expected that both sides may soon be printed by using a fluted plate to protect one impression, while the

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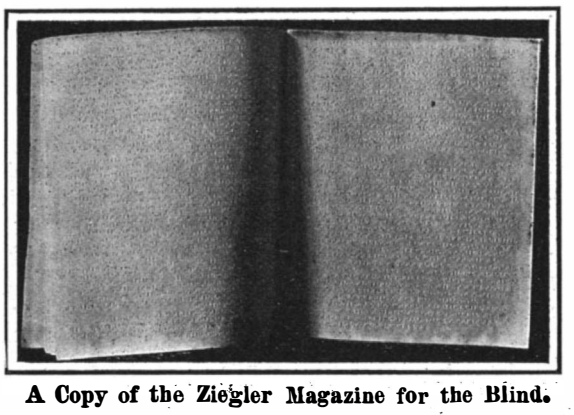
other is being made. This will double the capacity of the press and reduce the magazine to half its present bulk.

After the sheets are dried they are placed in piles on a long table, the successive piles being so arranged that the magazine may be assembled by picking up the pages one at a time from consecutive piles. The work is done by girls, as is also the binding of the magazine. It is the policy of the Ziegler Publishing Company to employ blind operatives as far as possible, and this part of the work is especially adapted for such hands. Not all the girls in this department are sightless, but it has been noticed that the blind attend more strictly to their work and make fewer mistakes than their seeing associates. In the foreground, at the center of the picture of the assembling table, is a girl who, in addition to being blind, is a deaf mute. The chance of working at the printing plant and of actually earning money is one of the greatest blessings of her life. It appears that in doing work which requires the exercise of but one of the senses the possession of other faculties is often a hindrance rather than a help, as they tend to divert one from the work in hand. Thus the blind deaf mute, while apparently at a greater disadvantage than the other girls, does the best work in the department.

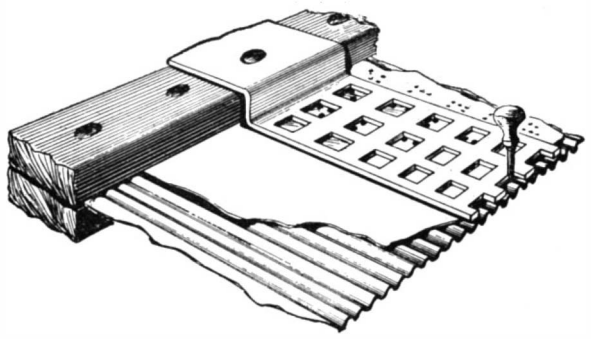
A rather interesting psychological study may be noted in the photograph just referred to. At the right



A Copy of the Ziegler Magazine for the Blind.

of the deaf mute is a girl in possession of all her senses. By gazing at some fixed object, to hold her attention, she was able to keep fairly quiet while the plate was being exposed, and made a fairly good picture. But the blind girl, at the left, was constantly distracted by various sounds, and unconsciously moved her head to follow the sounds, while her fingers were not quiet an instant, but persisted, involuntarily, in feeling of the edges of the magazine on which they rested. Had the hands hung idle and some loud steady sound, such as an electric bell, been used to fix her hearing, she would probably have made as good a picture as the rest. But it is doubtful if she would have maintained the absolute rigid quiet of the blind mute. When the mute was posed and made to understand by signs that she was to keep perfectly still, her entire attention was bent on following out her instructions, and with neither sight nor hearing to distract her, she was able to stand through a long exposure apparently without moving a muscle.

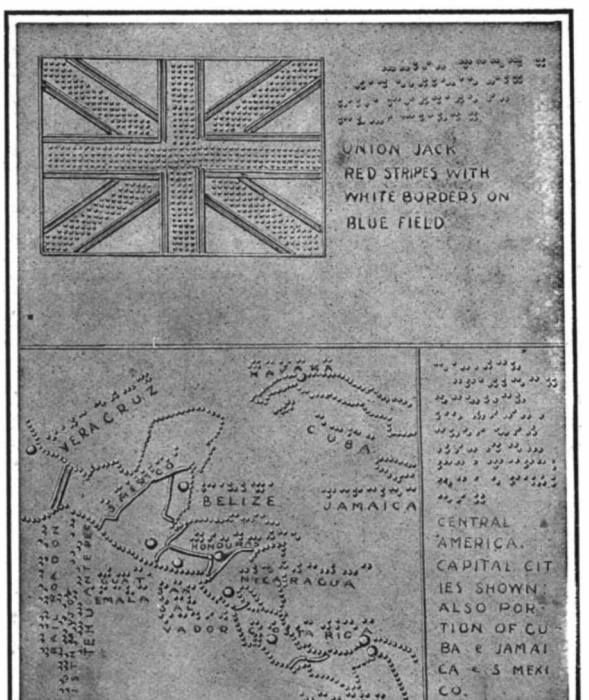
One of our engravings shows a typewriter for the blind, also the slate used by the blind in writing letters to each other. The typewriter impresses point characters on the letter sheet. Several keys are depressed at a time to form each character, and in some cases two characters may be impressed at the same time. The slate which is used for handwriting consists of a corrugated metal plate set in a wooden frame. The paper is placed on the corrugated plate and over it is fitted a metal guide strip in which several rows of rectangular openings are cut. The slate pencil is in the shape of an awl, and is used to punch the paper to form the point characters. The corners of the rectangular openings are used as guides for the awl. Two openings provide all the places necessary for the longest New York point character, six of the corners being used for the points, and the other two being skipped to provide the space between characters. When the three lines of the guide strip have been filled, the strip is moved down over a fresh surface of the paper. The rapidity with which this point writing is done and the facility with which the point alphabet is read are remarkable. That the marvelously sensitive touch and acute hearing of the blind is not intuitive, but acquired, is shown by the fact that a large proportion of this class were not congenitally sightless, but lost the use of their eyes after reaching maturity. The fact that they can develop their senses in this way is a great blessing to them. The man who suddenly loses his sight, after a short period of despondency, awakens to a realization of the value of his other senses and finds that he can put up a fair struggle in competition with his seeing associates. This very struggle is an inspiration and the blind are almost always happy, while many of them are justly proud and even a trifle conceited over their accomplishments.



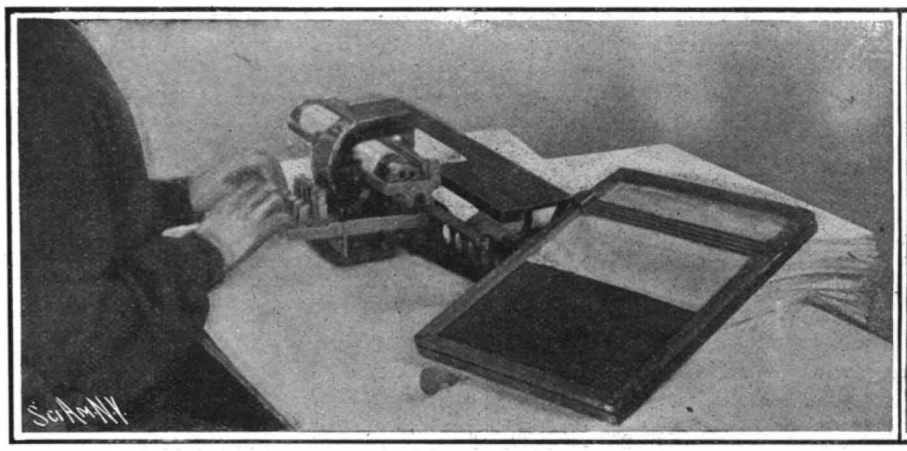
Details of the Blind Man's Slate.

The New York Point alphabet and punctuation marks
Punctuation Marks Comma Semicolon Colon
Period Interrogation Exclamation Quotation
Dash
This Prefix indicates that the characters following it
are numerals: 1 2 3 4 5 6 7 8 9 0

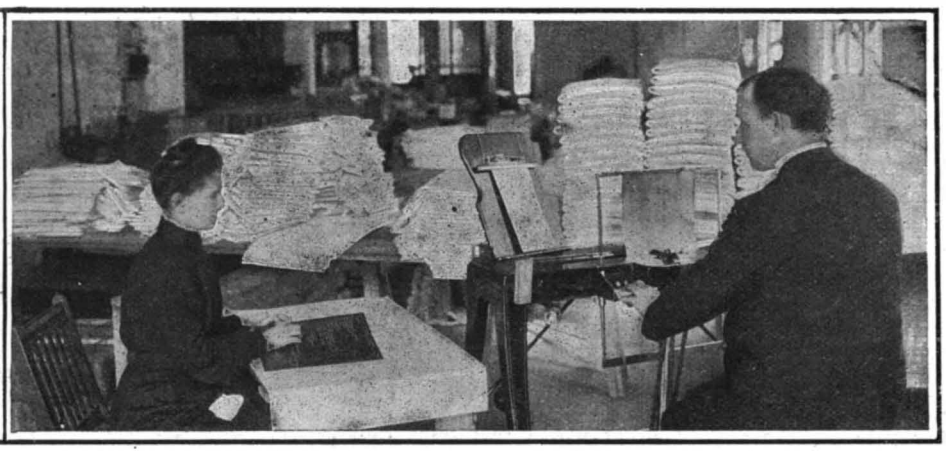
The New York Point Alphabet, also Numerals and Abbreviations.



One of the Cover Plates Showing How Maps and Illustrations Are Made for the Blind.

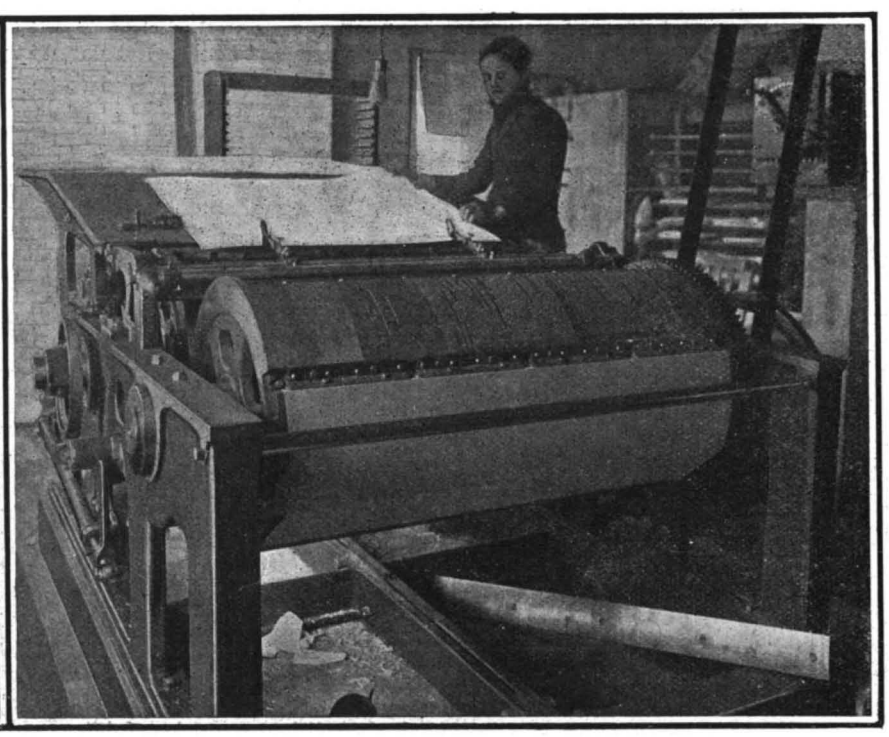


The Point Typewriter and the Slate Used by the Blind in Writing Letters.



Preparing a Plate on the Composing Machine; at the Left is a Blind Proofreader.

The Magazine is Assembled by Picking up a Sheet from Each Pile.



The Roller Point Printing Press Which Prints 10,000 Pages per Hour.

A MAGAZINE FOR THE BLIND.

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HOW CAVE AIR IS USED TO REGULATE THE TEMPERATURE OF A HOUSE.

BY C. H. CLAUDY.

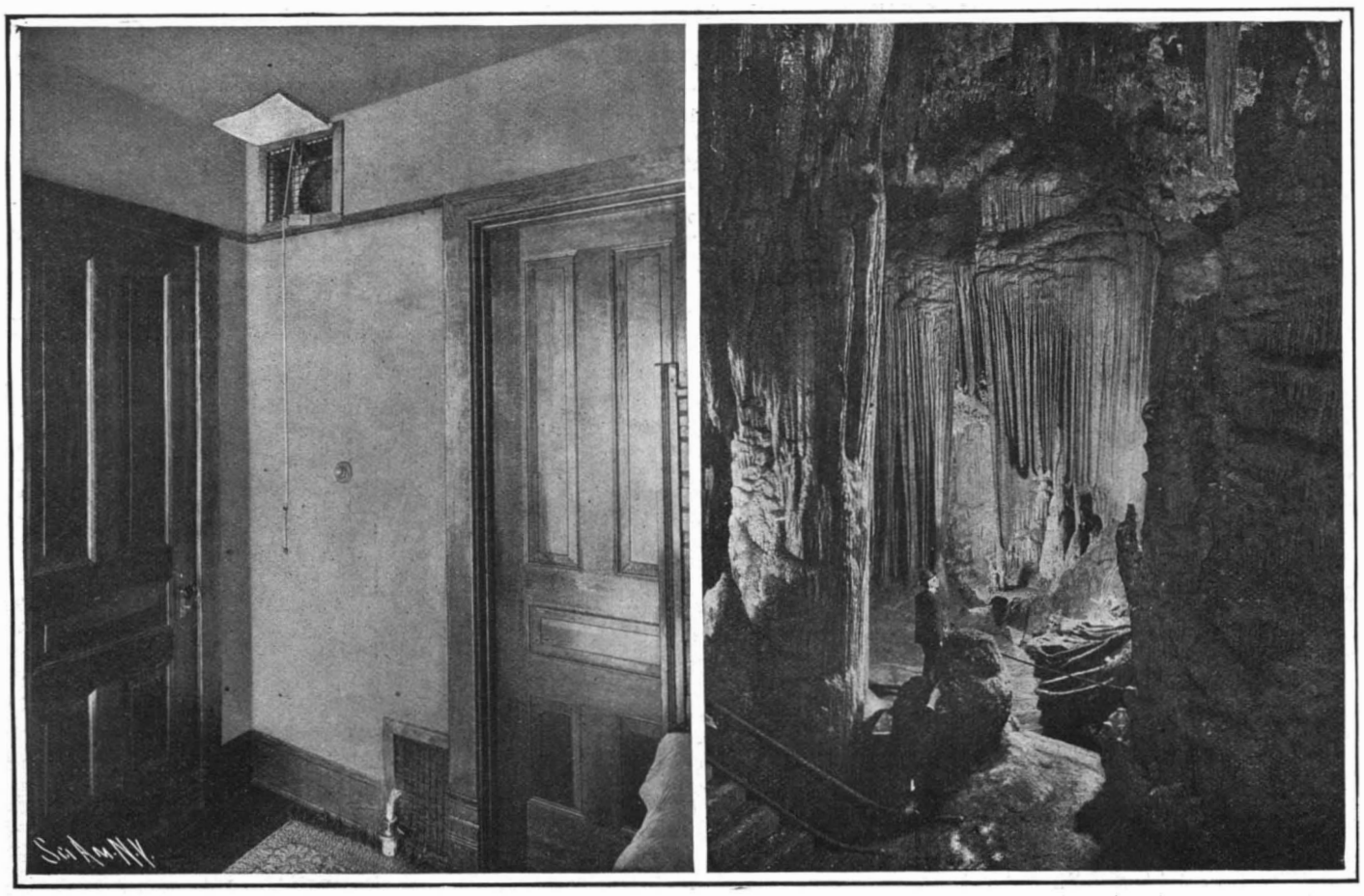
In Page County, Virginia, a mile from the town of Luray, stands a house that is perfect in its ventilation, and whose inmates breathe as pure air as any house dwellers in the world. The house is built on top of a hill, above the famous Caverns of Luray.

Connecting the caves with the surface is an artificial air shaft. Connecting this shaft with the house is a large passageway, and through this passageway, air from the caves is pumped into the house at the rate of eight thousand cubic feet a minute. "Limair," the name of this unique homestead, is the result of years of labor and preparation. Mr. T. C. Northcott, who built and owns the house, is a retired heating and ventilating engineer. It had long been his dream to secure property on which could be built a house embodying some pet theories, one of which is to the effect that air filtered through limestone is pure and healthful and aseptic. Now, as to the practical advantages; in the first place, the entire cubic contents of the house is changed every four minutes during the day and night, so there is never any foul air. As the air is practically germless, no sickness can ever be contracted in the house from germ causes. As the ventilation is so perfect, windows need never be opened except for cleaning them, and the result is a house which is nearly dustless. As the air supply from the caverns fluctuates in temperature only two degrees in the year, from 54 to 56 deg. F., the temperature of the house is under absolute control. On the hottest day in summer the interior of the house is cool and comfortable at 70 deg. An open fire can be built every night in the year with comfort, and is built frequently even during the summer. In the winter, the cave air, slightly warmed by passing over steam coils, heats the house, and the inside is always at 70 deg.—or whatever the particular temperature desired may be. Finally, the humidity is always normal in "Limair"; it is regulated to 70 per cent at a temperature of 70 deg. Less is too dry; more, too damp. Tests have been made with culture mediums and plates to determine the amount of bacteria in the cave air, and all but very few of the results were entirely negative, the two or three positive results revealing so minute a quantity of germs as to be practically negligible. It is interesting to compare the results made in different localities. For instance, on tests made in the caverns, in various parts, on twelve plates there were two colonies! In nine plates in the house, six colonies resulted, in one test.

In one plate in a nearby farm house, perfectly clean and considered a fine dwelling, 143 colonies resulted. On one plate made in a city back yard, 450 colonies resulted. On one plate made in a New York street car, 1,600 colonies resulted. Two plates in the finest operating rooms in Johns Hopkins University showed 65 and 58 colonies. In other words, the cavern air is practically germless, aseptic, and pure.

How can the air from a dark, damp cavern be pure and sweet like the air which is sunlit and constantly moving? All the air in the cave is drawn from outdoors, and has been sun-cured! Moreover, it is not stagnant air at all; the difference in the temperature from inside and outside keeps up a constant circulation of air, which is drawn in and exhaled through thousands, probably, of small openings in rock and earth. The air is filtered through limestone.

Cave air—lime-cave air—is considered ideal for all troubles of the throat and lungs; consumptives have, before now, tried living in caves. But the lack of sunlight



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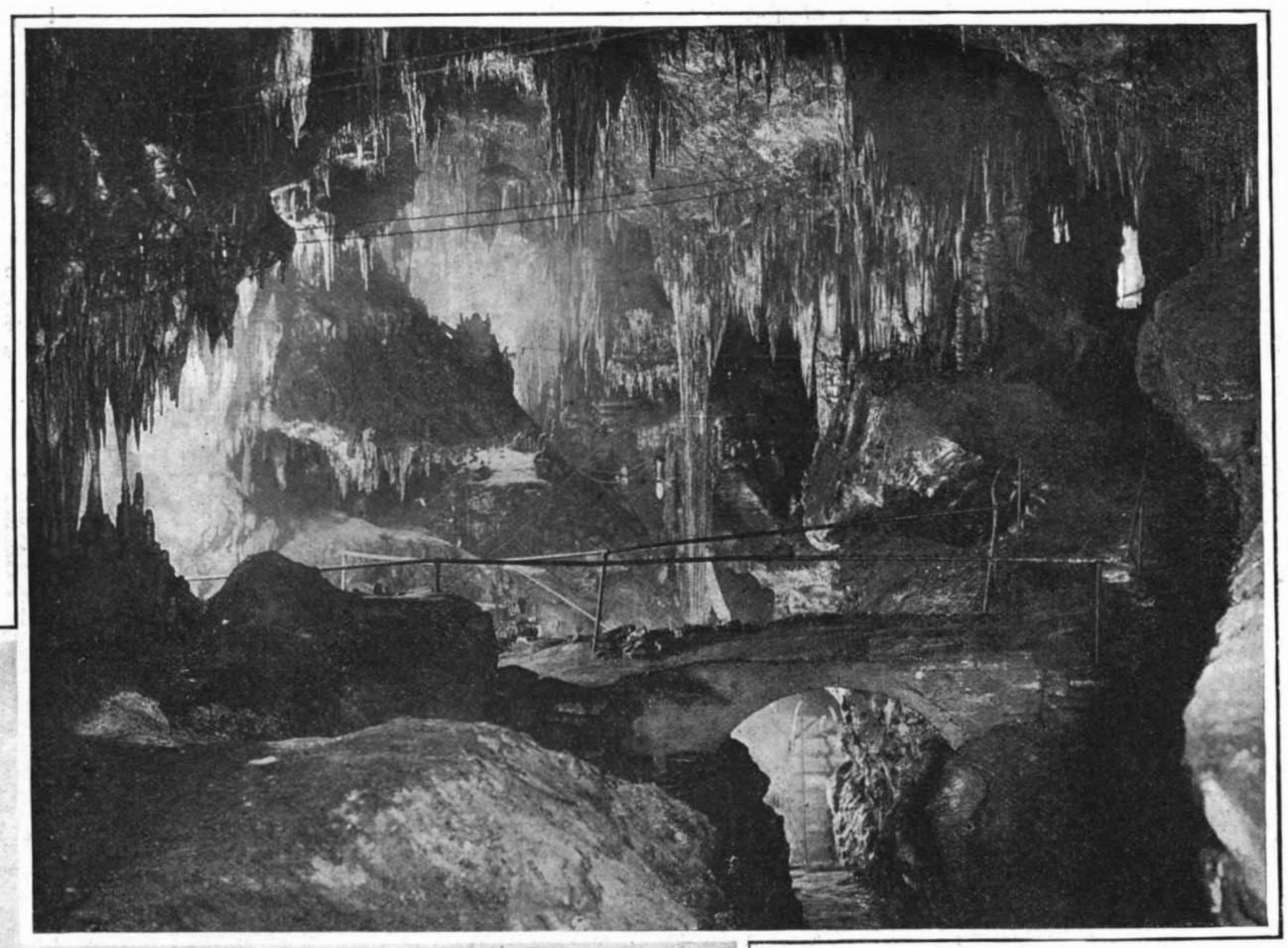
Ventilation; In and Out of a Room.

A Glimpse of the Stalactite Formation.



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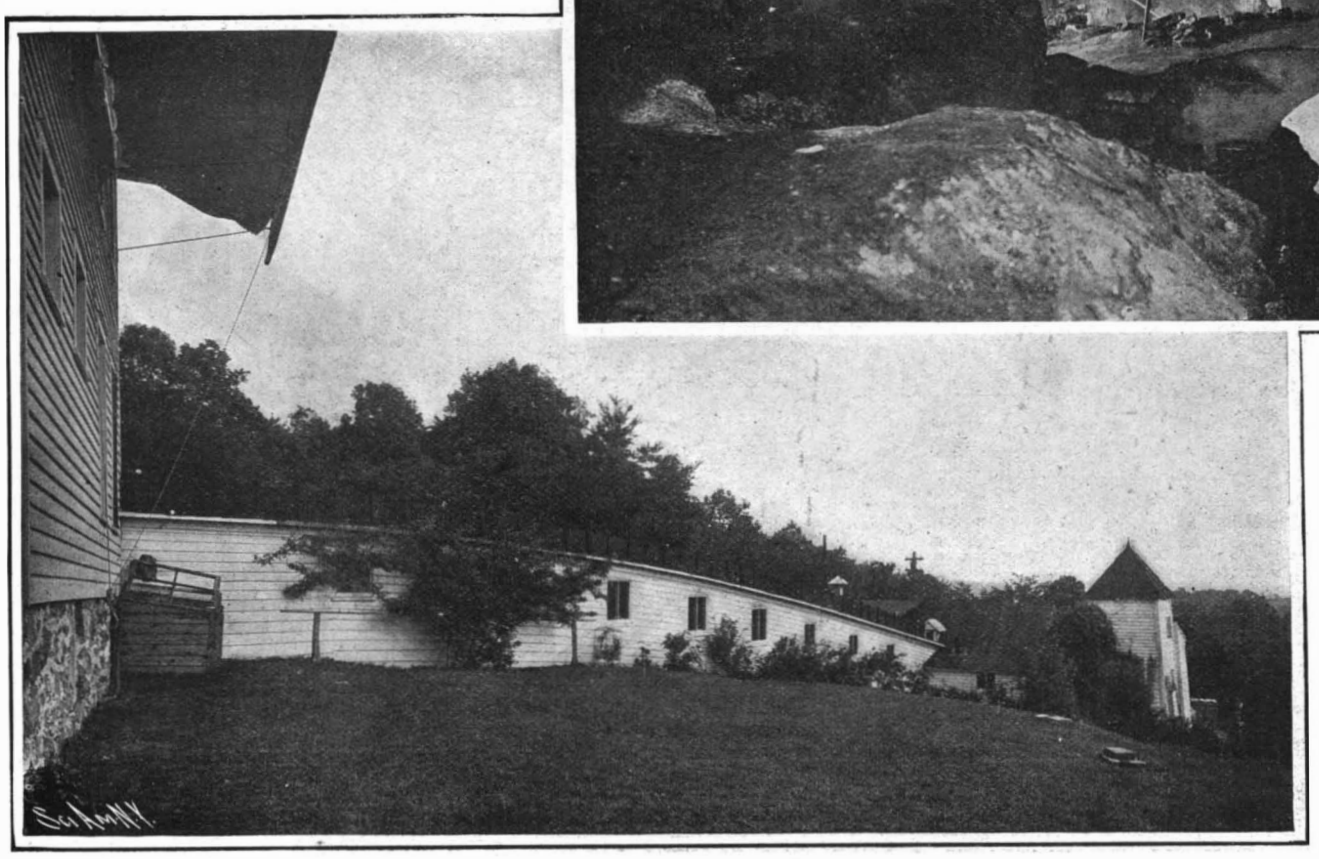
The Caverns of Luray; One of the Largest Chambers.



The Air Shaft Conducting the Cave Air to the House.

HOW CAVE AIR IS USED TO REGULATE THE TEMPERATURE OF A HOUSE.

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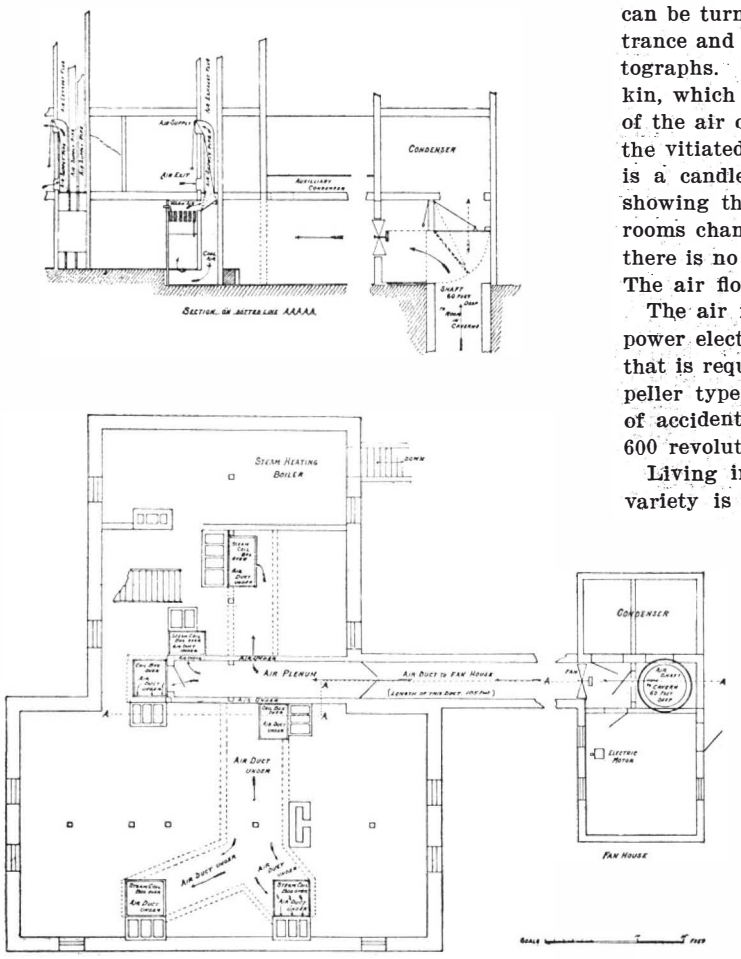
and the dampness did more harm than the pure air did good. But in "Limair" one has the pure air and the sunlight and the lack of dampness all together.

Dampness is entirely relative. A certain amount of air, at a certain temperature, will always absorb the same amount of water. This amount is stated in percentages. But a per cent of moisture at one temperature will be different as the temperature is raised or lowered. Consequently, the humidity normal to the caves, 87 at 54 deg., reduces itself to 70 when the temperature is raised to 70 deg. In other words, when the air is expanded by raising its temperature, the moisture lessens in quantity because the quantity (bulk) of air is increased.



Plan and Elevation of the Basement, Air Duct, and Air Shaft.

Some details as to the practical arrangement of this house may be interesting. The location of the house was first determined from the outside. Then a survey was run in the cave through a passageway entirely off the regular "run" for visitors, and this survey was made entirely by candle light. The survey comprised a great many twists and turns and great differences in elevation. The same distance and direction were surveyed on the outside, and a 35-foot shaft, 5 feet in diameter, was sunk. When the shaft broke through into the cave, a plumb, dropped from above, was within three inches of the corresponding stake in the cave. The shaft drops 35 feet through the hill, and the top of the chamber into which it breaks is 25 feet from the floor, so the total depth is 60 feet. The shaft house where the fan is located is 100 feet from the house, and connected thereto with the air ducts shown in the illustration. This passage is double, the top being of tin and the bottom of wood. The metal duct is used both as condenser and to warm the air slightly by sunlight when desired; the lower chamber is used when it is desired to have the air reach the house just as it comes from the cave.

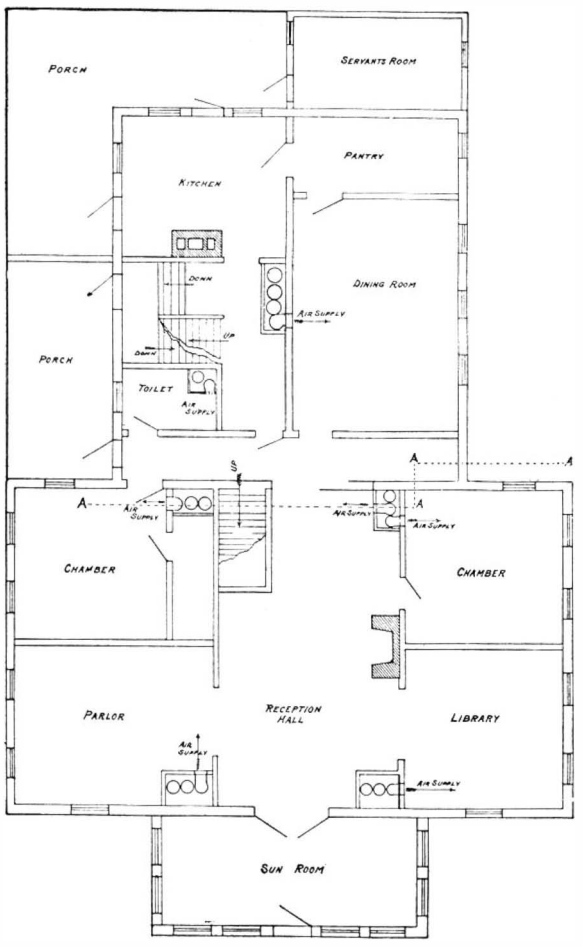
All the air goes to a large plenum chamber in the basement. From here it flows up through smaller shafts to the various rooms in the house. At the base of each of these smaller shafts is a steam coil, which is heated in winter time. A valve is so arranged to each ventilator shaft exit that the warm or cold air can be turned on at will. The arrangement of the entrance and exit ventilators is shown in one of the photographs. Above the top ventilator is a paper napkin, which is blown out at a right angle by the force of the air coming in. At the bottom ventilator, where the vitiated air goes out to be discharged out of doors, is a candle, the flame of which is deflected inward, showing the current of air. Although the air in the rooms changes completely in from four to six minutes, there is no draft to be felt at any time or in any place. The air flows, rather than blows.

The air is propelled into the house by a five horse-power electric motor, of which three horse-power is all that is required. It is a 42-inch fan of the disk or propeller type, with a gasoline engine in reserve in case of accident to the current. The fan runs from 400 to 600 revolutions a minute.

Living in a house of this kind after the ordinary variety is somewhat a novel experience. The writer has been in "Limair" in both summer and winter. In winter, except for the refreshing sleep, due to more fresh air in a minute than the usual sleeping room gets in a night, the features do not strike the casual observer until they are pointed out, but it needs no guide to show the summer visitor that something is different in this house. To come in out of a blazing sunny day with every pore a-drip with perspiration, and have to fetch a wrap in five minutes to avoid cooling off too suddenly, if overheated—to sit comfortably dressed in a temperature of 70 deg. with everything boiling outside, is a new experience.

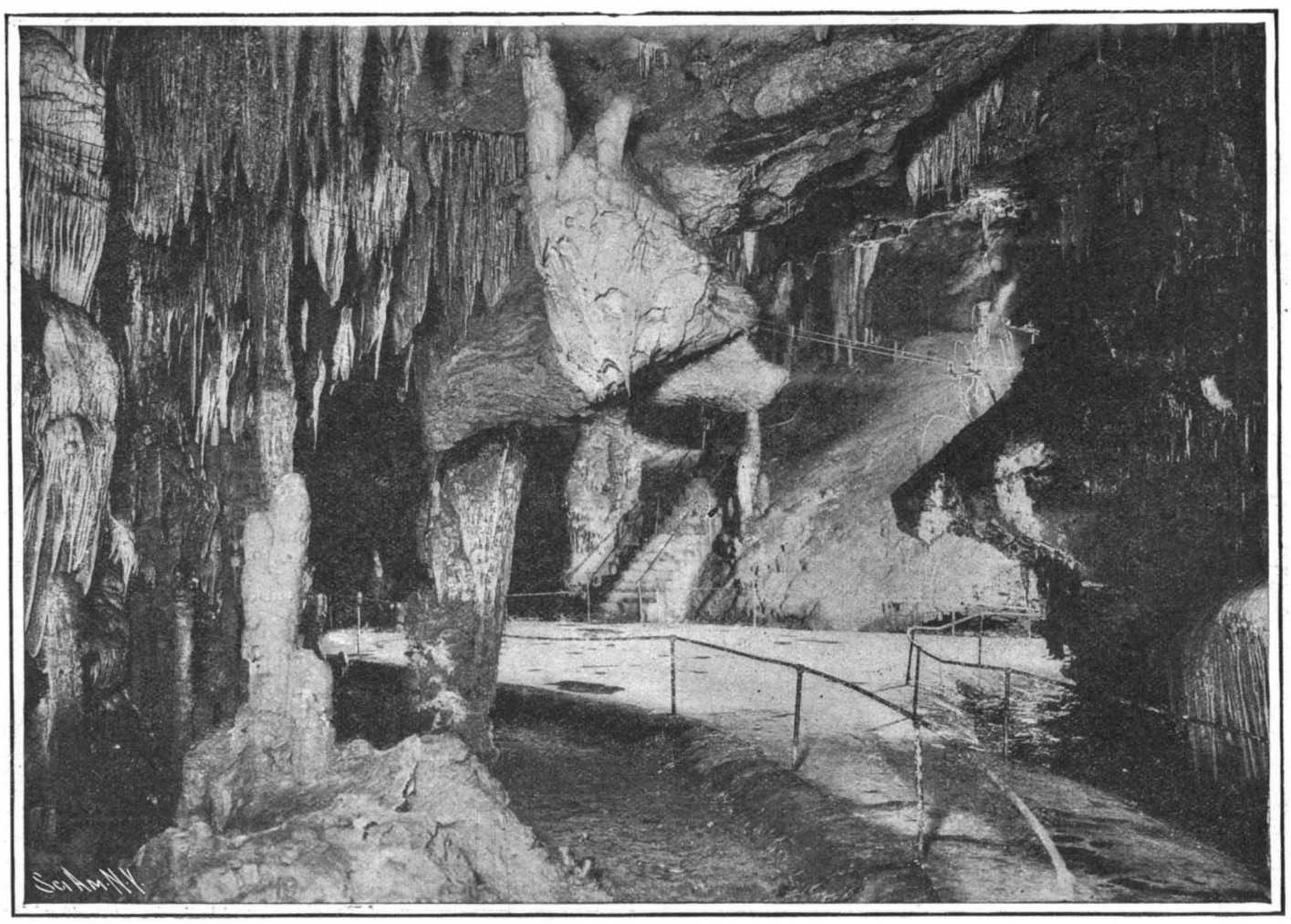
The accompanying plans show the basement of the house, the first floor, and a section through the house and shaft reaching to the cave. These show the simple yet highly effective means employed to control the temperature and relative humidity of the air, and to distribute it and deliver it in the required volume to the various rooms in the house.

As the air comes from the shaft it may be thrown directly to the passage leading to the house, or by means of a bypass valve be sent through a condensing chamber before it reaches the fan. It is here that the relative humidity of the air is regulated. After leaving the fan the air goes through a duct 4 by 7 feet and 105 feet long, to the plenum chamber in the basement of the house. From the plenum chamber reach six different passageways for air, all below the floor level. From all of these six locations or distributing centers rise iron pipes 12 inches in diameter, and one of these pipes goes to each room in the house. These pipes are placed within large metal-lined flues. The central pipe carries the fresh air, and the flue about it carries off the vitiated air—if air which has been in a room four minutes can properly be called vitiated. The large ventilating flues continue to the attic, where they all open into a "gathering chamber," from which the air which has been throughout the house passes to the outside air again.



First Floor Plan, Showing Air Shafts.

At the base of each pipe through which air is supplied to the rooms of the house is a mixing valve, controlled by a cord passing through the pipe to the room the pipe supplies with air. This valve controls the temperature of the air reaching a room, by determining the proportions of normal cave temperature and steam-heated cave air which are to form the body of air delivered to the room. The section elevation shows this arrangement plainly; the cord is visible in the photograph showing the ventilators in a sleeping room. Of course, heat is used only in cool or cold weather, there being no necessity or desire to heat the air in summer.



The Caves from Which the Air is Drawn.

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HOW CAVE AIR IS USED TO REGULATE THE TEMPERATURE OF A HOUSE.

It is reported that a French scientist has devised an apparatus capable of indicating as low as the one-hundred-thousandth part of the carbon dioxide present in the air in a closed room. The indicator is based on the fact that carbon dioxide will liberate iodine from a chemical combination of that element, and the gas so released will effect a coloring of chloroform. The carbon dioxide contained in the air should never exceed one part in one thousand.

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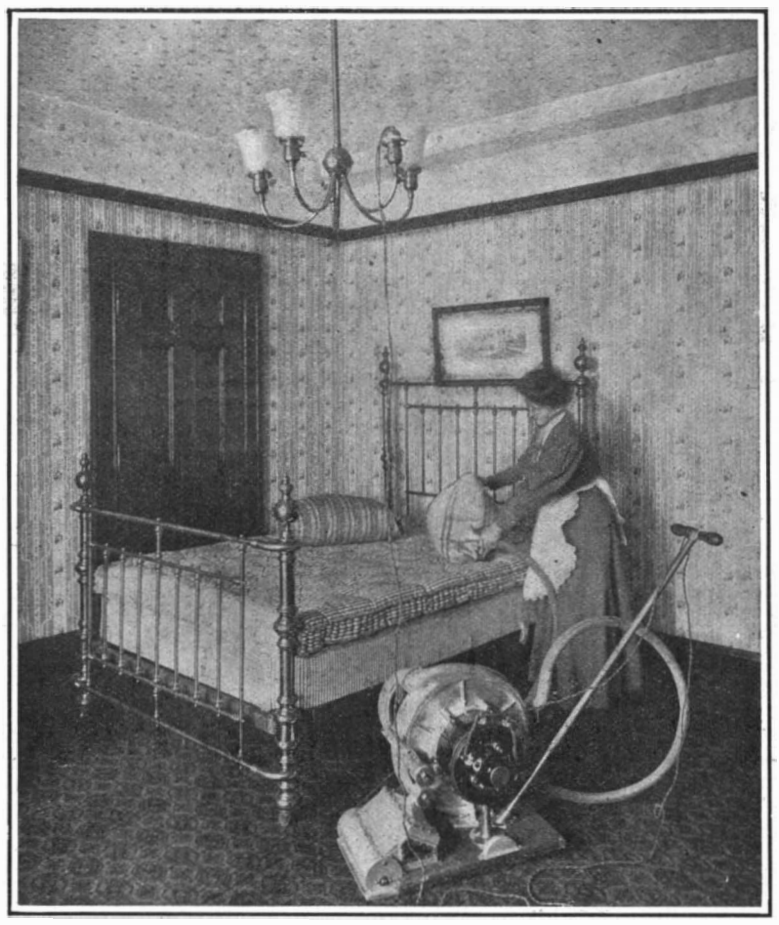
A NEW ELECTRIC RENOVATOR.

A novel adaptation of the vacuum cleaner principle to light domestic work is shown in the accompanying illustration.

A small but powerful electric motor is mounted on wheels, and fitted with a handle after the manner of an ordinary carpet sweeper. Power is obtained by connection with an electric light fixture. In carpet sweeping a rapidly-revolving brush loosens the dirt and dust, which is then drawn into the cleaner by a revolving double fan and dropped into a separator. Matches, paper, and heavier fragments fall into a separate drawer.

For other household cleaning special attachments are provided, fitted to flexible tubes. One of these is used for cleaning cushions, mattresses, and upholstery in general. This may be done either by suction or by forcing air through the material to be cleaned; in practice the dust is usually first drawn into the machine, and a current of clear air afterward driven through the cleaned object. A second attachment is adapted for cleaning corners, crevices, and other awkward places, while a third is used for cleaning walls, curtains, moldings, and similar surfaces.

The work of the cleaner is very thorough, the suction of the air tending to reach the under-surface dust, which is often passed over by mechanical brush sweepers and similar appliances.



A NOVEL ELECTRIC RENOVATOR.

A FRENCH UNIVERSAL SYSTEM OF MACHINE MOLDING.

BY FRANK C. PERKINS.

It has generally been considered among modern foundry owners that machine molding is only practicable when a great number of castings of the same pattern are required, and such castings are flat, with a lot of taper, and therefore easily molded. Most of the molding machines in use are simply presses actuated by hand, or by compressed air or hydraulic power, but little attention is paid to making the pattern plates, when this is the main point to be considered in machine molding. It is on this account that machine molding is so little used.

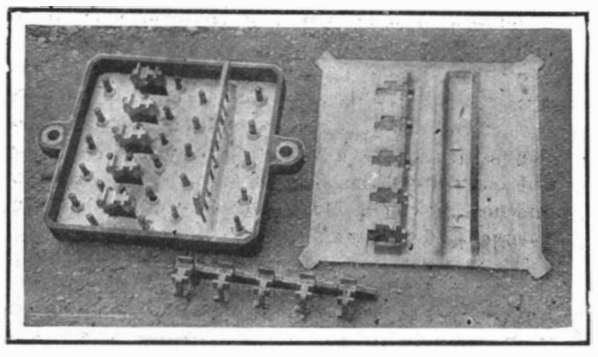
With the ordinary means employed, the making of pattern plates is very expensive even for easy castings, and in order to obtain the required accuracy, first-class fitters are required. For motor-car castings, which are more or less intricate, it is necessary to make a special and very costly machine for each casting. Very often special flasks are needed, which are accurately machined, adding still further to the cost, and in most cases the above reasons have caused founders to conclude that machine molding is not practical.

The new French universal system of machine molding is said to have largely done away with these drawbacks and difficulties, and it may be of interest to consider it in some of its details, as the new process is said to be really "universal," and conforms to all possible cases, from the easiest castings to the most intricate ones; and this is accomplished with an enormous saving, not only on hand molding, but on the accepted and general machine molding now in use. The molder is himself able to make the pattern plates, as the whole system has been designed especially for making the pattern plates and stripping plates in the foundry without depending upon the machine shop. Even the most intricate pattern plates are made more cheaply and quickly than by any other system, and this enables the founder to make them to advantage for as few as fifty castings.

In one of the accompanying illustrations there is a very good example of the reversible pattern plate, indicating clearly the number of patterns used on the plate and the results obtained.

A great part of the core, cylindrical, or extremely intricate work can be made on the machines by different combinations, and it is absolutely true in position and accurate in size. Heavy cores in the drag can be molded direct on the machine. No accurately machined boxes are required, as the machines can mold either with non-machined flasks when dry molds are needed, or with only a few boxes when green sand is used. When a casting is not too large, and of such a shape to allow it, reversible pattern plates are used, so that when two boxes are rammed off, a complete mold is the result, and the number of castings obtained is doubled.

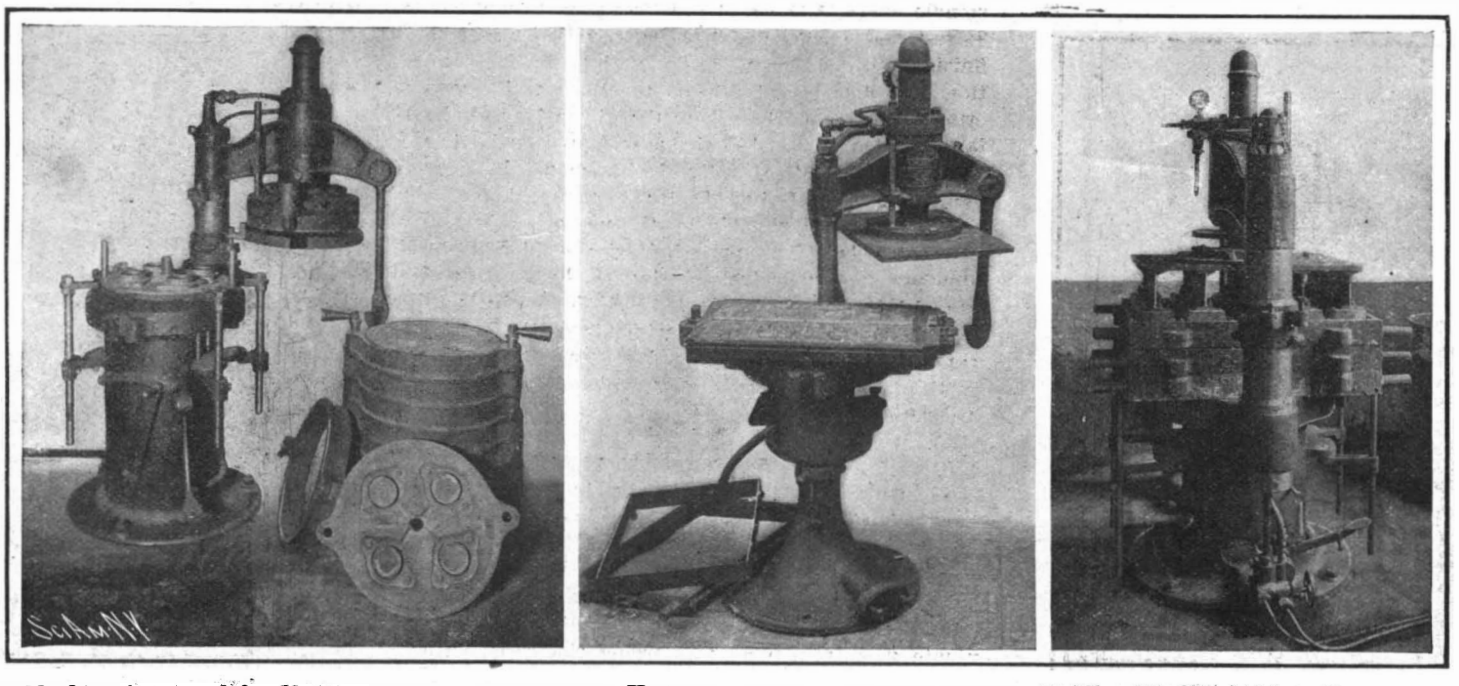
A special appliance has been designed for smaller pieces, which is really a small reversible pattern plate, and is called a "cliche" appliance. It is made in a very short time, and is entirely of metal. One of the accompanying illustrations shows a small hydraulic molding machine arranged with extension brackets to take the cliche table. The piston for the pattern drawing mechanism is worked by a pedal in this machine, while the others have a cylinder after the style of the ramming cylinder, and work simultaneously. It will be noticed that the various sections are in place in this cliche table. A cliche is made by an average molder in from one-half hour to two hours, and is made from an ordinary pattern such as is used every day in the foundry, two castings for each pattern.



A Reversible Pattern Plate.

A machine for molding the top and bottom of the molds at the same time, so that they can be placed one on top of the other, is also illustrated herewith, together with a number of the castings made on this machine. It will be seen that for this process there are two pattern plates, one on the table of the machine in the usual way, and the other bolted to the ramming plate. This same machine is also arranged for ramming flasks with bars, as very often when a shallow mold is required with a large surface, it is impossible to hold the sand together over the large area without bars. These molding machines are capable of making from fifty to eighty half molds per hour, according to the skill of the operator and the nature of the work. The machines of various sizes are designed to take flasks from 10 inches by 10 inches to 3 feet by 5 feet and even more.

With their limits the machines will take any size and depth of flasks, any style of castings, and any style of pattern plates. Vibrators can be used if required, and intricate pattern plates with stripping plates can be mounted in a moment. Hydraulic power is used instead of compressed air, and after careful consideration of the advantages and disadvantages of hydraulic power and compressed air, the former agent with a pressure of 750 pounds per square inch was selected on account of the perfect and steady movements obtained either in drawing the pattern or in ramming. It is stated that one horse-power is sufficient to drive from four to six molding machines, which is about twenty times less than that required for compressed-air machines, while the first cost and maintenance of the hydraulic plant is said to be trifling as compared to the first cost and maintenance of a compressed-air plant of the same working capacity.



Machine Arranged for Molding Top and Bottom Molds at the Same Time.

Hydraulic Molding Machine With "Cliché" Table.

Molding Machine Arranged for Ramming Flasks With Bars.

A FRENCH UNIVERSAL SYSTEM OF MACHINE MOLDING.

Steel Belting.

Consul Frank S. Hannah, of Magdeburg, writes that in a recent issue of a German technical paper, the use of steel bands to take the place of leather belting for the transmission of power is stated to have proved practicable after repeated tests by a firm in Charlottenburg, its advantages being given as follows:

The points of superiority claimed for this new method for the transmission of power are the following: On account of its solidity a much narrower band can be used, one-sixth of the width of the usual leather band being sufficient; as a result of this the steel band is not so heavy as the usual band, and, as it can be very tightly adjusted, the distance between the engine and the machine is not a matter of importance, as is the case with the leather belting, where the transmission of power is dependent upon the weight of the hanging belt; by a unique contact, the slipping is much reduced, experiments showing not over one-tenth of 1 per cent. The entire loss of power is very small, about 1 per cent. By the lightness of weight of the steel belting, the influence of the centrifugal force is not so great, allowing increased velocity.

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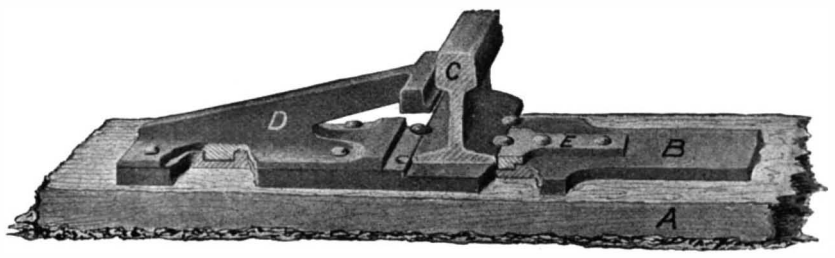
Patent Department

RAIL LOCK AND TIE PLATE.

A combined lock and tie plate for railway rails has recently been invented, which is adapted to effectually prevent the rails from spreading or having any lateral movement. The device may be used on any form of sleeper, and is of simple and durable construction. Our



RAIL LOCK AND TIE PLATE.

illustration shows a section of a track on which this lock and tie plate is used. Secured to the tie *A* is a plate *B*, which extends practically the entire length of the tie under the rails *C*. The plate is formed with a shoulder at each end, which bears against the outer base flange of each of the opposite rails. The rail lock comprises two sections, indicated respectively at *D* and *E*. The brace section *D* is provided with a lug, which enters a recess in the tie plate *B*. This serves to hold the brace section in fixed relation to the tie plate and rail *C*. The brace section is formed with an upward extension, which terminates in a wide head adapted to fit against the head of the rail. The guard section *E* of the rail lock is fitted against the inner edge of the base flange of the rail. This section is also held in position by means of lugs, which enter recesses in the tie plate *B*. Both sections of the lock are secured by means of spikes driven through the tie plate into the tie. Probably in practice it will not be necessary to use more than one lock to each rail, and where the lock is not used, the rail may be secured to the tie plate in the usual manner by means of spikes driven into the sleeper through the tie plate. A patent on this rail lock and tie plate has recently been secured by Mr. William N. Reynolds, of Litchfield, Conn.

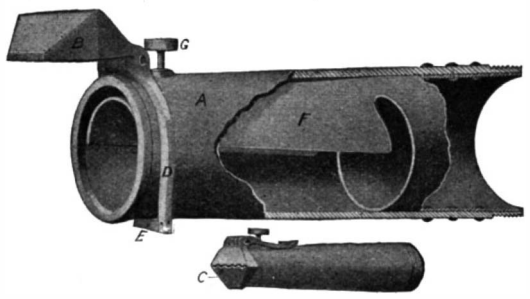
FOLDING WASHING MACHINE FOR STATIONARY TUBS.

Pictured in the accompanying drawing is a folding washing machine made for stationary tubs. It is of light weight and can conveniently be applied to any tub. The wash is cleansed by alternate pressure and suction and there is no rubbing. Hence, there is no wear or tear of even the finest fabrics. The machine will operate with equal facility on heavy blankets. It comprises two leaves, each of which is composed of transversely-arranged slats. The leaves are hinged together at one end and one of the leaves is secured to the bottom of the tub, while the other is arranged to swing toward and from the stationary leaf so that the water and suds in the tub will alternately be drawn in and forced through the clothes placed between the leaves. It will be observed that the slats are beveled at one side. The purpose of this is to catch the clothes to prevent them from slipping out when the upper leaf is forced down upon them. The lower leaf is provided with a pair of vertical side bars which are hinged thereto and which are secured to the sides of the tub by means of U-shaped clamps. No special adjustment is required to accommodate the washing machine to various quantities of clothes. If a large number of pieces are put under the swinging leaf, the latter is operated at a greater angle with the lower leaf. At one side the two leaves are cut away to provide access to the drain, or discharge pipe of the tub, so that the plug may be removed without lifting out the machine, and the wash water may flow out without being impeded by the clothing in the machine. Whenever desired the clamps may be loosened and the machine lifted out of the tubs and completely folded. In its folded position the machine takes up little room and may be conveniently carried about. The inventor of this machine is Mrs. J. W. O'Connor, 106 East 81st Street, New York.

FOLDING WASHING MACHINE FOR STATIONARY TUBS.

HOSE NOZZLE WITH MOVABLE SPRAY CAP.

The accompanying engraving illustrates an improved hose nozzle, provided with a movable spray cap and an independent means for regulating the volume of water which passes through the nozzle. The spray cap is hinged to the outer end of the nozzle, and may instantly be brought into active position whenever desired, adapting the nozzle for spraying plants, shrubbery, and the like. The nozzle consists of a tapered tube *A*, which may be connected to any suitable cut-off cock on the hose. The tapering tube is oval in cross section. The spray cap is indicated at *B*, and is hinged to the outer end of the tube *A* in such manner that it will drop over the end of the tube. The spray cap is formed with a sinuous opening *C*, through which the water passes to become a spray. At one side the cap is provided with an arm *D*, at the free end of which a locking member *E* is secured in such manner that it may be slipped under the tubular body *A* to hold the spray cap open, and over the tube *A* to hold the cap closed.



HOSE NOZZLE WITH MOVABLE SPRAY CAP.

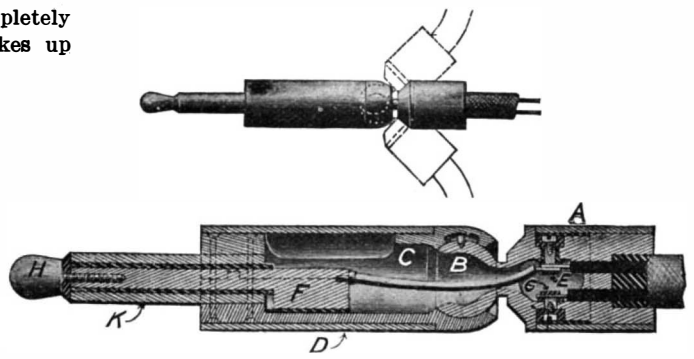
Within the tubular body *A* there is a spring valve *F*, comprising a plate shaped to conform with the inner wall of the nozzle and cut away toward the front end, where it is substantially semi-circular in form. A thumb screw *G* in the top of the tubular body bears against the spring valve *F*, and provides a means for depressing the valve, thus partially closing the nozzle and controlling the flow of water. The inventor of this hose nozzle is Mr. Sugaji Suzuki, of 2204 Quincy Avenue, Ogden, Utah.

Prof. Myers's New Airship.

Prof. Carl E. Myers, of the balloon farm, Frankfort, N. Y., announces that he is constructing for western use the largest airship yet built by himself or any one else in this country. It is of his well-known spindle shape, and has a circumference and length of 84 feet and a buoyancy of 1,700 pounds. This will be finished in two weeks, when he will begin construction of a still larger airship on the lines of the government specification, but twice the dimensions of the late accepted bid. Within the past five days he has wholly constructed two captive hydrogen gas balloons and nets for the United States government. This speed is only made possible by the use of ready machine-varnished hydrogen-proof fabrics originated by him and in use exclusively during thirty years, and from which he has already built 150 hydrogen balloons for the War and Weather Departments of the United States. Ordinarily, by the usual systems it requires from thirty to sixty days to completely varnish a hydrogen-tight balloon.

IMPROVED SWITCHBOARD PLUG.

An element of considerable expense in all telephone exchanges is the maintenance and repair of the switching cords. The cords give way just below the point where they are attached to the plug, because when inserted in the switchboard they are bent at right angles and twisted at this point. Efforts have been made to eliminate this trouble by reinforcing the cords with braids, but the cord trouble seems to remain almost as great a disadvantage as ever. A ball and socket plug and cord connection has recently been invented, with the purpose of overcoming this defect. This plug is shown in the accompanying engraving. The cord is fitted into a head *A*. The latter carries a ball *B*, which engages a socket *C* secured to the plug proper. The socket *C* is made in two pieces, which are bolted together, and over them is fitted a sleeve *D*. The two terminals of the cord *E* and *G* are secured to posts in the head *A*. The terminal *E* connects by a flexible wire to a bar *F* and button *H*, which is suitably insulated from the plug, while the terminal *G* is electrically connected through the metal casing of the plug to the sleeve *K*. The plug may be used in the usual



IMPROVED SWITCH CORD PLUG.

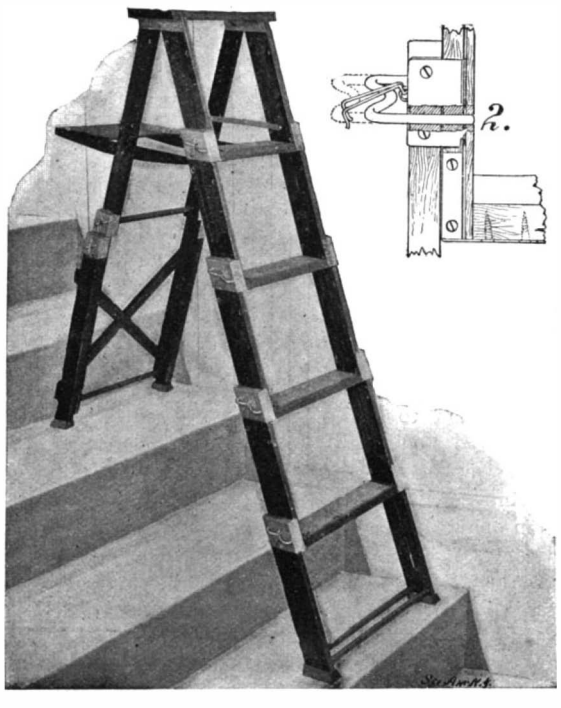
manner on any switchboard, and when inserted in the switchboard the head *A*, owing to its ball-and-socket connection with the plug, is free to move in any direction, as indicated by dotted lines in one of the views. The ball-and-socket joint also prevents twisting the cord when the plug is moved laterally to different parts of the switchboard. A patent on this switchboard plug has been granted to Messrs. E. L. Smith and G. F. Childress, of Wills Point, Texas.

FOLDING STEP LADDER.

Painters and paper hangers often find it necessary to use a step ladder on a stairway or in some other inconvenient place, where the tread part of the ladder must be set on a different level from the legs.

In such conditions a folding ladder, like the one here illustrated, would be found indispensable. This ladder is not intended for the use of decorators alone, but is adapted for all the requirements of the household. Both the tread portion and the supporting legs are made in sections which may be separately folded, as desired, to make either side longer or shorter than the other. When both sides are fully extended, the ladder has the proportions of an ordinary step ladder, and when both sides are folded the ladder is reduced to one-third its original length, so that it may be stowed away in a small space.

The tread portion of the ladder is formed with a separate section for each step. Each section slides within the one below, and may be secured either in the extended or folded position by a double pin at each side, as shown in the detail view, Fig. 2. This method of coupling the sections makes a very strong and firm joint. A small wire hook is suspended above each double pin and serves as a retainer to prevent the pin from being entirely withdrawn. This does away with the danger of losing the pins and keeps them always in position for instant use. The leg portion of the ladder is composed of fewer sections, but by providing intermediate holes on each section for the locking pins, it is capable of the same adjustment as the tread portion of the ladder. The usual folding brace is provided to hold the leg and tread portion apart and the ladder is furnished with the ordinary extension board to hold a pail or the like. The inventor of this folding ladder is Mr. Albert Dahl, of 302 West 144th Street, New York City.



FOLDING STEP LADDER.

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RECENTLY PATENTED INVENTIONS.

Electrical Devices.

RHEOSTAT.—J. W. MERTZ, Mount Clemens, Mich. More particularly the invention relates to a type of rheostat of special service in connection with arc lamps for the production of moving pictures. The more particular purpose is to give the operator a more extensive control over the current so that he can closely graduate the resistance and govern it completely within wide limits.

CURRENT-DISTRIBUTING DEVICE FOR IGNITING EXPLOSIVE-ENGINES.—H. DE LA VALETTE, 111 Boulevard de Menilmontant, Paris, France. The object of this invention is to avoid the serious drawback which often happens in apparatus where the sparks move off and to a distance between the different metal pieces and thus give rise to untimely ignition in the cylinders, and the invention consists in a particular fitting of the insulating parts separating the several metal pieces used for the in-coming and out-going currents.

Of Interest to Farmers.

CORN-HUSKER.—S. H. MINNIS, Carrollton, Mo. The husker is designed to be worn upon the hand during the operation of husking. The inventor's object is to produce a device which can be readily and quickly attached to or detached from the hand, which is positive in its action and protects the upper part of the hand and thumb from the action of the corn-husk.

COTTON-PICKER.—I. A. MURCHISON, Manchester, N. C. The improvement relates to cotton pickers, the more particular purpose being the production of a small picker suitable to be carried in one hand and in which the picking mechanism and movable parts for operating the same are of comparatively simple construction.

BAND-CUTTER AND FEEDER.—A. BÖTTCHER, Benndorf, near Delitzsch, Germany. The invention comprises two endless traveling feed-carriers in the cross direction only of the thresher, a reciprocating pusher movable in the longitudinal direction of the thresher and adapted to push the grain off the one feed-carrier to a chute leading to the threshing drum, an adjustable band-cutting disk and a reversible box for supporting the other feed-carrier and the band-cutting disk.

Of General Interest.

AERIAL APPARATUS.—M. B. SELLERS, Baltimore, Md. In this kite form of apparatus the wings operate as an aeroplane and the object of the invention is to produce a construction of the greatest lifting power for a unit area and one having little wind resistance, and which can be easily adjusted to properly fly in the practical operation of the improvement.

EYE-SHIELD.—G. E. HENRY, Philadelphia, Pa. One purpose of the invention is to provide a light shield adapted to be worn upon the nose in the same manner as an eyeglass, or which can be quickly and conveniently adjusted to the bow section of an eyeglass or the bridge of spectacles in such manner that the attachment can be readily removed when desired.

BELT-FASTENER.—P. A. HUDSON, New York, N. Y. This belt is simple and durable in construction and arranged to securely fasten the ends together, without danger of tearing the belt material and without producing undesirable thicknesses or projections on either face of the belt, thus allowing the passing of the belt with either face over the pulleys.

PIPE OR TUBE CLEANER.—E. A. JABLONSKY, New York, N. Y. In this patent the object of the inventor is to provide a pipe or tube cleaner, more especially designed for use in the water pipes or tubes of boilers to remove adhering scale and other extraneous matter in a very effective manner and in a comparatively short time.

LOADING DEVICE.—W. F. KLEWITTER, Mosinee, Wis. Mr. Klewitter's invention pertains to a loading device and has for its principal object the provision of a device in which the strain is evenly distributed through the frame. Still another object is to provide adjustable side braces which may be disposed from the top of the frame to the ground.

MITER-BOX.—J. MCCUNE, Santa Cruz, Cal. In this instance the invention refers to miter boxes, and is particularly designed to provide means adapted to enable a saw to be held in a vertically inclined plane while cutting diagonally across an object, so as to cut angles in two directions at the same time.

HOLDER FOR NURSING-BOTTLES.—M. L. SURPRENANT, Indian Lake, N. Y. The inventor has in view a holder for supporting and holding in convenient accessible positions while in use, an ordinary or other form of nursing-bottle, whereby the child may be in easy reach of the bottle and be relieved, to an extent, of its weight, in addition to it being impossible for the bottle to be dropped to the floor and broken.

ADVERTISING DEVICE.—I. O. THORLEY, Philadelphia, Pa. This device is particularly adapted for use in cars for indicating stations or streets, the object being to provide a device that will be simple in construction and in which are two sets of reversible or transferable slides bearing advertising matter, such for instance, as the names of streets or stations.

Hardware.

FUNNEL.—J. P. MURTHA, Little Rock, Ark. The funnel is provided with a large bowl or body and interchangeable spouts of different sizes, to permit convenient filling of large or small bottles, and to allow filling successively of a number of bottles with one charge and without danger of spilling or wasting liquid retained in the bowl during the transfer of the funnel from one bottle to another.

SAW.—J. DOWLING, Olympia, Wash. This saw is such as used by carpenters, and is provided with means for attaching the handle to the butt thereof. The handle is provided with spirit levels, the arrangement being such that the levels are protected from injury. The levels are accurately alined with respect to the rear edge of the saw blade which constitutes a straight edge.

Heating and Lighting.

MINER'S LAMP.—R. L. GRAVES, Sumpter, Ore. The invention relates to lamps in which paraffin, wax, or other solid fuel is used and is designed as an improvement on the lamp shown and described in an application formerly filed by Mr. Graves, the object being to render the lamp more convenient in handling, in that the wick tube can be readily removed and rewicked with little or no trouble.

DRYING-FLOOR.—H. O. ROBINSON, Brookline, and C. STEADMAN, Salem, Mass. One of the purposes here is to provide a heating floor for drying green bricks and like materials, the floor being so constructed that various heating agents can be utilized, namely, exhaust steam, chimney gases, or waste heat from kilns, and to so construct the floor that it is impervious, and so that the heat will be consistent throughout the entire floor area.

INCANDESCENT GAS-LAMP.—H. SÜSSMANN, 144 Alte-Jacobstrasse, Berlin, Germany. Mainly this invention relates to the particular formation of a closed air container. This container should be constructed in such a manner as to surround the chimney or chimneys through which the combustion gases are conducted wholly or partially through the incandescent bodies, and which at the same time receives the mixing device and mixing passage. The arrangement may also be such that only the burner head or heads and the incandescing bodies extend through the bottom of the air reservoir into the combustion chamber of the lamp.

Household Utilities.

EGG-OPENER.—D. P. STEVENS, Rio, Wis. The purpose of the invention is to provide a simple and economic opener so constructed that it can be expeditiously and conveniently operated, and the egg broken and its contents discharged in a cleanly manner, free from particles of shell. The empty shells are automatically discharged.

Machines and Mechanical Devices.

SYLLABIC KEYBOARD FOR TYPE-WRITERS AND TYPE-SETTING MACHINES.—H. G. MCCOOL, Carmichaels, Pa. In the present patent the object is to obtain great speed and thus enable more work to be done in a shorter time than has been heretofore possible on typewriters and analogous machines. To accomplish this, both letters and syllables are used in a new arrangement or association.

BALANCED PUMP.—A. P. SMITH, Sumpter, Ore. The object of the inventor is to provide a pump, arranged to require comparatively little power for operating the pump by employing two simple-acting pumps, of which one delivers through the other, and the descending plunger of one pump aids the lifting of the water in the other.

MEANS FOR USING FROM A DISTANCE THE VARIATIONS IN TEMPERATURE.—J. B. FOURNIER, 62 quai des Orfèvres, Paris, France. In this case a manometer comprises a curved manometric tube and having its other end closed, both tubes containing liquid and the above named tube containing in addition a solid material distributed substantially throughout its entire length so as to restrict the space left for the liquid held within the said tube.

Prime Movers and Their Accessories.

CARBURETER.—W. L. WAYRYNEN, Dolph, S. D. More particularly the invention refers to means whereby a mixture of uniform composition may be formed irrespective of the quantity of gasolene or other fuel in the supply tank and irrespective of the speed of the engine. The presence of impurities in the liquid fuel does not interfere with the operation of the device, as no needle valve or fine passage is employed.

MEANS FOR PRODUCING MOTIVE POWER.—J. L. TATE, Jersey City, N. J. An object of this invention is to utilize the products of combustion of a liquid or gaseous fuel for operating an engine and to add to the products by the injecting action thereof, a second fluid of a low temperature, whereby a motive fluid is formed of a temperature sufficiently low to prevent injury to the engine, but, at the same time, of high pressure and velocity.

INTERNAL-COMBUSTION ENGINE.—C. J. MUNDHENK, Freeport, Ill. The invention relates more particularly to improvements in the cylinder and cylinder head construction whereby the cylinder may be more efficiently and uniformly cooled, the means for distributing the cooling agent being so disposed as to aid in the support of the cylinder and strengthen the same.

COMBINATION GAS AND STEAM ENGINE.—M. S. FLAIG, La Crosse, Wis. The intention in this improvement is to provide a new combination gas and steam engine, in which a mixture of steam and gas under pressure is produced in a very economical manner, and the said mixture is utilized to drive the engine to the fullest advantage.

Pertaining to Recreation.

CALCULATING DEVICE.—T. T. CROUCH, Chicago, Ill. This scientific device is for use in handicapping horses at different race tracks, different weights, under different conditions and ridden by the same or different jockeys; and also for arriving at track conditions. The invention consists in the novel construction and arrangement of the mechanical parts including the shiftable dials and index hands moving over the dials and adjusting the same, whereby the results are carried out in a simple, rapid, and correct manner.

REEL-CRANK.—J. J. NEWLANDS, New York, N. Y. The invention refers to reel-cranks, such as used by fishermen, the more particular object being to provide improvements in the construction whereby the practical length of the hand crank of the reel is changed at will, and also improvements in the means whereby the crank may be locked in a predetermined extended position.

POKER-TABLE.—I. MASON, New York, N. Y. A purpose here is to provide a table top for the game of poker, which poker top is adapted to constitute an auxiliary top for the table, particularly for a table having a rectangular top member, and also to so construct the auxiliary top that it can be quickly and conveniently placed and held in position on a table and as easily removed, without in any manner marring the table.

FISHING-FLOAT.—M. E. LOEHR, Claypool, Ind. The aim of this improvement is to produce a float of simple construction adapted to rest upon the water, and which is provided with a line carrying a hook. The construction is such that when the hook is taken by a fish, the device operates to strike so that the fish becomes caught. The device indicates whether it has been snapped or not; that is, whether or not a fish is on the line.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

HINTS TO CORRESPONDENTS.

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References to former articles or answers should give date of paper and page or number of question.

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(10759) V. E. M. asks: 1. What is the method of making a small battery such as is used in a small vest-pocket electric light? The battery can be bought for about 25 cents. A. The battery for lighting miniature lamps usually contains three dry cells. We published in our SUPPLEMENT, Nos. 1383 and 1387, price 10 cents each, a full description with illustrations of the manner of making such cells, with all the materials used and all necessary instructions. 2. What is the method of making a Fuller battery? A. The Fuller cell (see SUPPLEMENT, No. 159, price 10 cents mailed) is a bichromate cell in which there is a continuous amalgamation of the zinc. The zinc is in the bottom of the porous cup, and has a quantity of mercury, an ounce to a cell will answer, poured around it, which maintains the amalgamation of the zinc through the life of the cell. A brass or copper rod covered with gutta percha is fastened to the zinc, and extends above the cell as a terminal to which the circuit is connected. The carbon plate is placed in the glass jar and surrounded with a bichromate solution. Water is poured into the porous cup upon the zinc. The acid diffuses through the porous cup fast enough to act upon the zinc and produce the current. The cell evidently will not furnish a strong current. A good formula for the bichromate solution may be given: Take 21 ounces of sodium bichromate and 3 quarts of water. When the solution of the salt is complete, add slowly and with constant stirring, 1 pint of strong sulphuric acid. The solution is ready for use when it has cooled.

(10760) W. D. O. says: I would like to know the composition of the preparation with which the particles of carbon, in the carbon pencils for electric arc lamps, are held together; that is, the cementing substance. A. Arc light carbons, carbon plates for battery cells, and similar articles are made from coke. The higher grades are made from coke derived from the residue of petroleum stills. The crude material is dried, ground fine, and sorted into different sizes. The binding material may be a coal-tar product, or some other substance containing carbon, and which will be reduced to carbon by the heat of the furnace. These are thoroughly mixed, pressed into forms by hydraulic pressure, and afterward baked in a furnace. For a full description see SUPPLEMENT, No. 1237, price ten cents.

(10761) R. S. C. asks: Why, if known, does the skin of a chameleon change in color, in moving from an object of one color to one of another color; that is, why does its skin always assume the same color as the object it may be resting upon? A. One answer to the question, "Why does the chameleon change the color of its skin?" is that the chameleon has a better chance of life by reason of this protective resemblance to its surroundings. Those chameleons which had the largest range of change of color in the past have survived, and the capacity of change has been evolved in their descendants to a higher degree, so that all chameleons now living readily change the color of their skins to that of the bark of the tree upon which they at the time may be. They are thus protected from their enemies. There are many such adaptations of creatures to their habitat or environment. The polar bear, living among Arctic snows, is white. The tiger in the jungles is striped, as if painted to resemble rushes, reeds, or other stiff and straight plants. Many fish have backs of the hue of the sand or sea bottom upon which they lie. Nature has thus attended to the needs of her weaker children. Another answer might be that the effect of the color of the surroundings is to produce a change in the pigment in the cells of the skin, so that the color becomes like that of the surface upon which the animal is resting. In the chameleon this is comparatively rapid.

(10762) W. A. T. asks: Would you kindly give me directions for a spark coil for 3-horse-power gasoline engine? Size of core, feet, and number of wire for primary; also feet and number of wire for secondary. I have 550 feet of No. 18 cotton-covered wire that I would like to work into the coil. Want coil to give about ½-inch spark. A. SUPPLEMENT, No. 1281, gives full information concerning a coil for gas engine ignition, if one has general knowledge of the work of construction. Lacking this, it would be best to get Norrie's "Induction Coils," price $1, which gives detailed instruction in this work, together with tables of data for all the parts of coils of all sizes up to a 12-inch spark. Do not use so coarse a wire as No. 18 in a secondary coil, and use a coarser wire in the primary. Two layers of No. 14 will be right for primary, layer 6 inches long. Three-fourths pound of No. 36 silk-covered will be right for secondary to give a half-inch spark. Core should be ⅞ to 1 inch in diameter and 7 inches long. 2. If a person sparked his engine with a magneto, would he need a coil also? A. A magneto can be made which will render a coil unnecessary, but a battery and coil are necessary till the machine has speed enough to enable the magneto to generate.

(10763) C. S. J. asks: I wish to learn the cause of trichinæ in pork. A. The trichina spiralis is a worm, a parasite of the hog. It is often found in great numbers in the flesh of these animals, in the encysted condition but still alive. If such meat is eaten without cooking thoroughly, the parasite is taken into the body and is rapidly propagated. The worm came originally from the rat. As hogs eat rats, they pass into the hog and thence into man. The only preventive is thorough cooking. This kills the trichinæ. No rare or underdone pork should ever be eaten. The risk is too great. The cost of immunity is so little that anyone may be safe. Cook all pork thoroughly. 2. The cause of ptomaine poisoning by eating pork. What causes the presence of the poison, how the poison can be prevented, and whether or not there is any way of detecting the presence of poison before using the meat? A. Ptomaines are formed by decomposition. If only fresh food is used, one will be safe from these poisons.

(10764) J. A. H. asks: Will you kindly explain how voltmeters and ammeters can be read to 1/10 their divisions? A. A scale is usually read to a tenth of a division by estimating the fractional part in tenths with the eye. This is of course not accurate, but the best that can ordinarily be done. The error, with experience, need not exceed a tenth. Sometimes voltmeters and ammeters are provided with shunts, which change the value of a division of the scale. Thus you can have a shunt made which will make one division have one-tenth of its present value. This will be much better than to estimate by the eye the fractional part of a division indicated by the pointer.

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NEW BOOKS, ETC.

THE AMERICAN BATTLESHIP AND LIFE IN THE NAVY. By Thomas Beyer. Chicago: Laird & Lee, 1908. 12mo.; pp. 246. Price, $1.25.

A book devoted to a description of life in the United States navy from the standpoint of the seaman must necessarily possess a special value. Literature bearing upon the navy, whether in description of the ships, or of the life led by those who form the ships' complement, is plentiful; but these delineations of a naval man's life at sea are more or less of a fictional character. Hence the present volume, written by a "ship's fitter of the first class" in the United States navy, and based on his personal experience, has a special value of its own, and will be welcomed by that large class of readers who wish to learn about life on the ships of our navy as it actually is. The book divides itself naturally into two parts, the first half dealing with the day-by-day life of the seaman, his duties, drills, pastimes, chances of promotion, etc., and the second half containing an excellent description of the manner in which the ships are designed and constructed, and the uses to which they are put. The first chapter deals with the building and commissioning of the vessel, and the way in which officers are made. Chapter II. describes the preparations for a voyage, the life at sea and in port, giving its daily routine and a description of the drills of the week. For those who are seriously thinking of entering the navy, and are seeking information regarding the life and its opportunities, Chapter III. will be found particularly useful. It describes the crew and their duties, under the head of Engineers' Department, Carpenters' Gang, Deck Force, Ordnance Department, Pay and Medical Departments, and the Clerical Force. The rates of pay are given, and the opportunities for advancement both in rank and remuneration. The chapter closes with a description of the amusements and pastimes and a curious dictionary of "Man-of-War's" lingo. The last three chapters are devoted to the description of a battleship, its ordnance, guns, gun crews, ammunition, projectiles, and torpedoes. The nomenclature of the different parts of the ship are given, with a clear description of the drainage, ventilation, and fresh and salt water systems; and it closes with a description of the United States vessels, which includes six pages of tables giving full particulars of the size, horse-power, speed, battery, weight of discharge from guns, and the number of men carried, on every important ship of the navy. The tone of the book throughout is healthy and optimistic. The author, as the result of his personal experience, is an enthusiastic believer both in the excellence of our ships and the quality of the officers and men who man them. It is worthy of a wide circulation, and should prove a valuable aid in encouraging the better class of men of this country to enlist.

THE COPPER HANDBOOK. A MANUAL OF THE COPPER INDUSTRY OF THE WORLD. Vol. VII. Houghton, Mich.: Horace J. Stevens. 8vo.; cloth; 1228 pages. Price, $5.

The new edition of the "Copper Handbook," Vol. VII, has just been issued. It has 1,228 pages, octavo, brevier type, being materially larger than before. The author apologizes for his inability to revise the book throughout, explaining that fire, sickness, and loss of five months' time prevented, but the new volume contains about 180,000 words of new matter in additon to the matter remaining unchanged from the preceding issue. This new edition of the "Copper Handbook" contains twenty-five chapters, an increase of nine, treating of copper under the headings of History, Geology, Chemistry, Mineralogy, Mining, Milling, Concentrating, Hydrometallurgy, Pyrometallurgy, Electrometallurgy, Alloys, Brands, Grades, Uses, Substitutes, Terminology, Geography, Copper Deposits, and Copper Mines and Statistics. The treatment given the subject is encyclopædic in scope, but the logical and orderly arrangement of the great mass of facts presented, coupled with the table of contents, full index, and alphabetical arrangement of districts, countries, mines, minerals, and glossary, render it possible to ascertain any given fact with almost as much ease as a word is found in a dictionary. This is a point of much value to readers that has been overlooked in many otherwise excellent works of reference. The "Copper Handbook" is not intended to replace other works for the use of technical men, but it does supplement all other technical books on copper, while for the average reader its hundreds of pages devoted to the scientific and technical features of the subject will be found to cover every point of interest. The language is plain throughout, and the layman will find the clear and easily understandable exposition of scientific facts a great aid, as the highly technical language used in many of the best scientific works is a serious stumbling block in the path of the man not technically trained.

STEAM TURBINES. By Carl C. Thomas. Third edition, revised and enlarged. New York: John Wiley & Sons. 8vo.; cloth; 334 pages, plates. Price, $4.

The logical arrangement of Prof. Thomas's "Steam Turbines" and the numerical examples applying the underlying principles to problems of design, have obtained for the book an extensive use by teachers in colleges, and by engineers wishing to master the fundamentals of the subject. The hydraulic, mechanical, and thermodynamic principles involved in turbine calculations are carefully but briefly set forth, and the methods of calculation actually in commercial use at the present time are employed in the problems worked out in the book. This gives the reader a grasp of the principles and methods of calculation, and conveys an understanding of the use of heat diagrams, velocity diagrams, and the graphical processes so generally used by engineers. The use of experimentally determined data, and the methods of design involving empirical coefficients are given prominence. The purpose of the book is to set before the reader principles and methods, and not to trace in detail the ever-changing mechanical arrangements found in practice. A careful working out of the practical examples contained in the book cannot fail to familiarize the student with that which is essential to a clear understanding of the action of steam turbines.

SOLDER. Its Production and Application. With a Brief History of Tin and Lead. By F. W. Schultz. Baltimore. 16mo.; cloth. Price, $1.25.

In this age of rush, any one desiring to give information must be very concise in order to have attention bestowed upon him. The author of "Solder" has shown his realization of this fact, and presents in plain and simple language the observations he has made during a period of nearly forty years, regarding the manufacture and use of this important compound. The two metals from which solder is made are no doubt among the first that were obtained by mineralogical process, owing to their low melting points. Just when the alloy of the two came into use is not known accurately, yet it must have been at a very early date. The author calls attention to an odd fact existing in connection with the melting points of solders containing different proportions of tin and lead. Starting with 56 parts tin and 44 parts lead, having a fusion point of 345 deg. F., the melting point rises gradually as the proportion of tin is increased and then falls until a mixture of 20 parts tin and 30 parts lead is reached, when the melting point is again 345 deg. F. Further addition of tin causes a rise in the fusion point. This is no doubt due to the formation of some sort of a compound of tin and lead, to the formation of an allotropic modification of one of the constituents, or to the change in the nature of the solvent.

MODERN PIGMENTS AND THEIR VEHICLES. THEIR PROPERTIES AND USES CONSIDERED, MAINLY FROM THE PRACTICAL SIDE, AND HOW TO MAKE TINTS FROM THEM. By Frederick Maire. New York: John Wiley & Sons. 12mo.; cloth; 266 pages. Price, $2.

The purpose of this book is to give a brief and concise history of all valuable pigments useful in painting—the main sources of their derivation and supply; their properties and chief uses; their good qualities and their defects will be pointed out and incidentally there will be presented the best methods of detecting adulteration. It is impossible in as small a volume as this to enter into the chemistry of pigments nor into some of the intricate details of manufacture and preparation for use, except in the briefest manner that will give the reader a fair idea of the composition. This is about all that painters or dealers require to know of the chemical side of pigments. Additional details would be of no importance, and no one but a manufacturer of colors would be interested in them.

AN INTRODUCTORY COURSE OF CONTINUOUS CURRENT ENGINEERING. By Alfred Hay. New York: D. Van Nostrand Company. 8vo.; cloth; 327 pages, illustrated. Price, $2.50.

This work is introductory in the sense that only elementary methods of treatment are made use of throughout, and that no attempt is made to cover the entire field of continuous current engineering. It furnishes a simple account of the component parts of a continuous current lighting and power plant—dynamos, motors, secondary cells, measuring instruments, and the other apparatus and principles with which it is well to be familiar.

INVENTIONS: HOW TO PROTECT, SELL AND BUY THEM. By F. B. Wright. New York: Spon & Chamberlain, 1908. 16mo.; pp. 108. Price, 25 cents.

The author states in his preface that this book does not pretend to teach inventors how to be their own attorneys, nor how to prepare and prosecute an application for a patent. The time-worn adage that he who is his own lawyer has a fool for a client, is as true of patent law as it is of other branches. This is good advice. We can hardly say as much for the section devoted to selling and buying as it is devoted simply to the suggested forms employed as licenses, transfers, etc.

PRINCIPLES AND PRACTICE OF ARTIFICIAL ICE-MAKING AND REFRIGERATION. By Louis Schmidt. Third edition, revised and enlarged Philadelphia: Philadelphia Book Company. 8vo.; cloth; 437 pages, 205 engravings. Price, $3.

The third edition of "Ice-making and Refrigeration" will be found to contain a large amount of new material, in addition to the greater part of the original matter contained in the former editions. The scheme of subdivision into four parts has been adhered to as heretofore, although there has been some rearrangement of material. All that need be said of this book is that it is already considered the standard work upon refrigeration.

THE FIRE ASSAY OF GOLD, SILVER, AND LEAD IN ORES AND METALLURGICAL PRODUCTS. By Leonard S. Austin. San Francisco: Mining and Scientific Press. 8vo.; cloth; 88 pages, illustrated. Price, $1.

A system of assaying, covering determinations of silver and gold, and of lead as well, according to the methods commonly recognized in the Rocky Mountain States. To prevent embarrassment to the beginner, but one method is described, although others of equal merit may exist.

THE THEORY OF LIGHT. A Treatise on Physical Optics. By Richard C. Maclaurin. In Three Parts. Part I. Cambridge, England: University Press. 8vo., cloth; 326 pages. Price, $2.75.

The treatise, of which this volume forms the first part, gives an account of the theory of physical optics that is systematic, and is as complete as possible within the somewhat narrow limits by which the work is bounded. The treatment is designed to lay a foundation for the establishment of the relation between light and electricity. The second volume will bring out this point more clearly; dealing with the branches not taken up in the first part, namely, dispersion, the rotations, both structural and magnetic, aberration, diffraction, etc. The connection between light and electricity is often imperfectly presented, for in many books it is not referred to, except in a sketchy way toward the close. The third and last volume of the series will be devoted to a history of optical theories. One of the features of the first volume, which as yet is the only one to have reached us, is the close connection maintained between theory and experiment.

AFTER EARTHQUAKE AND FIRE. A Reprint of the Articles and Editorial Comment Appearing in the Mining and Scientific Press Immediately After the Disaster at San Francisco, April 18, 1906. San Francisco: Mining and Scientific Press. 8vo.; cloth; 194 pages, illustrated. Price, $1.

A reprint of the articles and editorial comment appearing in the Mining and Scientific Press directly after the disaster at San Francisco two years ago. Although, following our racial custom, we have very nearly forgotten that such an event took place, the photographs reproduced show very clearly what are the effects of an earthquake. Some interesting remarks upon the cause of the displacement that did so much damage are also included.

ELECTRICAL RAILROADING, OR ELECTRICITY AS APPLIED TO RAILROAD TRANSPORTATION. By Sidney Aylmer-Small. Chicago: F. J. Drake & Co. Illustrated. 12mo.; pocketbook form and limp leather; 919 pages. Price, $3.50.

A book written principally for railroad men who have to do with the electrical machinery and apparatus which is installed upon steam roads, and for those who wish to keep pace with the increased use of electricity in all branches of life. No man can profitably refuse to learn something of this so generally used force. The style of the book makes it convenient to be carried in the pocket, and the method of teaching, while simple and elementary, is not insulting to the intellect. A more complete and satisfactory book it would be hard to imagine.

THE ENGINEERING INDEX ANNUAL FOR 1907. Compiled from the Engineering Magazine during 1907. New York: The Engineering Magazine. 8vo.; cloth; 435 pages. Price, $2.

The information on a given subject is so broadly scattered in this age of technical literature that it is impossible for a member of any profession to keep track of important articles that have a bearing upon his work unless there is at his disposal some sort of general index, or publication of classified abstracts. "The Engineering Index" furnishes a classified list of various articles germane to the subject that have appeared in the past year. The "classified" system is followed, instead of the "alphabetic" system of former volumes, as this method makes the locating of any special branch possible with greater facility.

WOOD. Manual of Natural History and Industrial Applications of the Timbers of Commerce. By G. S. Boulger, F.L.S., F.G.S., F.R.H.S., A.S.I. London: Edwin Arnold, 1908. 8vo.; pp. 348; 48 plates and 42 illustrations. Price, $4.20.

This is the second edition revised and enlarged of what has proved to be a most valuable work of reference. It is filled with interesting statistical matter, and the chapters relating to testing of wood, the various uses of wood; seasoning and storage of woods, are all very valuable. It is a most excellent work and is deserving of a large sale. The section devoted to woods of commerce, their sources, character, and uses, is arranged in alphabetical order, facilitating reference. There is also a select bibliography, and an appendix giving the distinctive microscope structures of woods. The book is well indexed.

INDEX OF INVENTIONS

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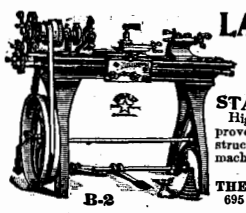

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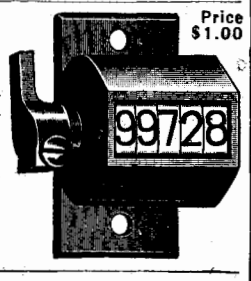

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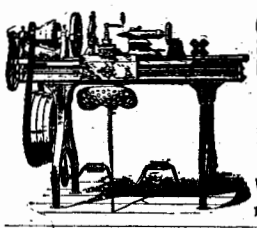

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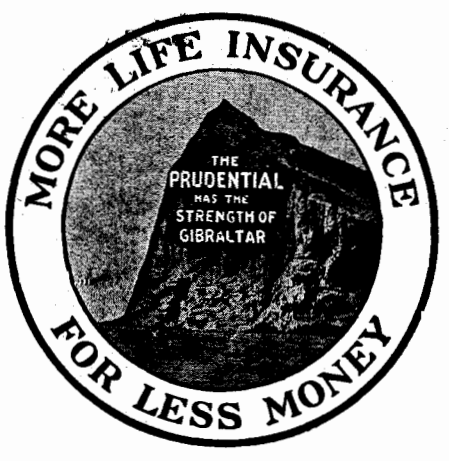

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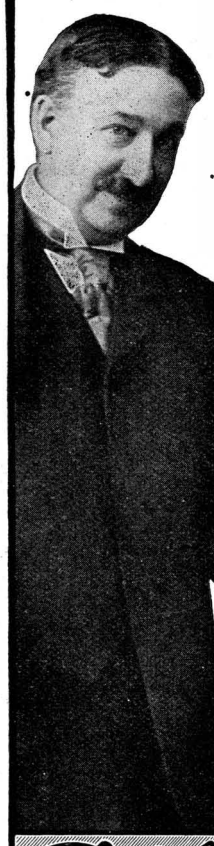

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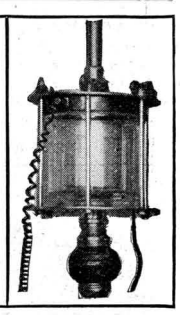

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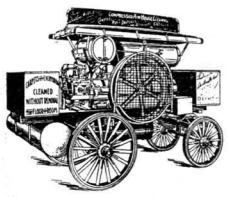

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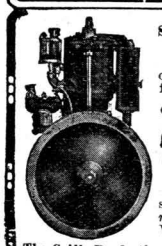

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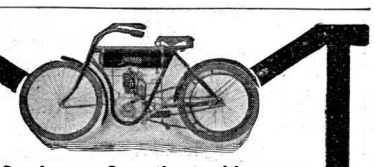

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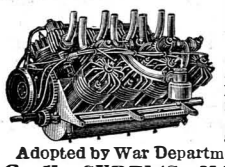

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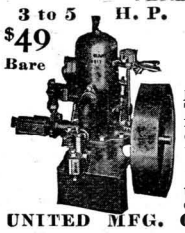

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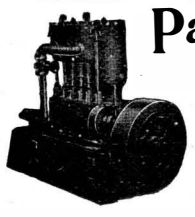

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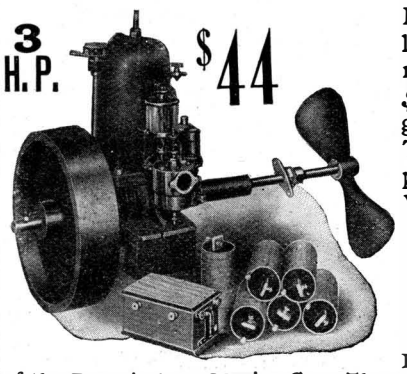
See Who Offers Them, Then Consider the Prices



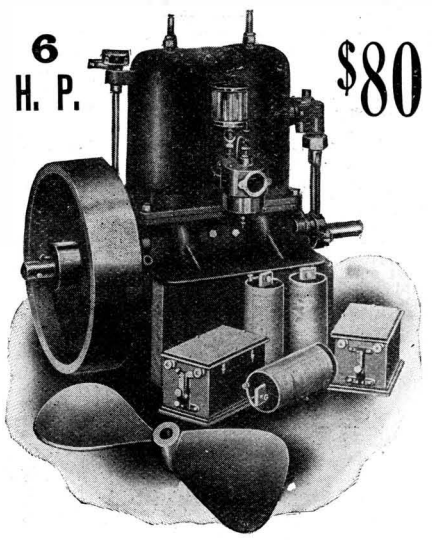
Here is the biggest real bargain in Gasoline Marine Engines you ever saw. A new Three-Horse-Power Engine for ***$44!*** Or a new Six-Horse-Power Engine for ***$80!*** Only a limited number. The stock won't last long at these prices. It's the chance of a lifetime. Write to-day for full information.

The Special Reasons for These Low Prices

A little over a year ago The Ferro Machine & Foundry Company purchased the entire interests of the Detroit Auto Marine Co. The Ferro Machine & Foundry Company immediately utilized their entire manufacturing facilities for turning out FERRO Motors, and the result was that a quantity of partially finished Detroit Auto Marine parts were left on hand.

These parts were principally of the three and six-horse-power sizes. As these parts of Detroit Auto Marine Motors were of no use to the Ferro Machine & Foundry Company nor to anyone else in this partially completed state, it was recently decided to finish and assemble these parts and place these three-horse-power and six-horse-power engines thus built on the market at less than cost, so as to clear up this extra stock at once.

These parts were crank shafts, connecting rods, carburetors, commutators, and the balance of the motors, including all castings, have been just recently manufactured They are made of the best material throughout and finished perfectly. It's the biggest bargain ever offered to the boat builder or the boat owner who wants to put an engine in his boat or replace his old engine.



Read What Users Say

Detroit Auto Marine Co.:—Your engines are the talk of the town. They run so steadily and propel the boats so fast. I have 4 boats to put engines into. I will have 10 or 15 more sold before the coming season.
C. H. SABIN, St. Albans, Vt.

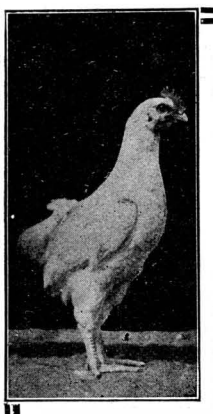
Detroit Auto Marine Engine Co.:—After a run of over 800 miles (60 miles on ocean) with 3 h. p. engine in my 30-ft. house boat, at an average of 4½ miles per hour, I want to say the little "Auto Marine" is as good and reliable as ever built at any price.
W. M. SMITH, Miami, Fla.

Remember, these engines are tested at the factory to develop their full rated horse-power. We will always have all parts on hand for repairs.

We will furnish you with price list so you can get any part of these engines any time promptly and at low price direct from our factory.

Write today—NOW—and we will send you full illustration and description of these engines and the various outfits that go with them.

The Ferro Machine & Foundry Company, Cleveland, O
Eastern Branch: Dept. I, 44 Cortlandt St. 2d Fl., New York



$200.00 in Six Months from 20 Hens

TO the average poultryman that would seem impossible, and when we tell you that we have actually done a $500.00 Poultry business with 20 hens on a corner in the city garden 30 feet wide by 40 feet long we are simply stating facts. **It would not be possible to get such returns** by any one of the systems of poultry keeping recommended and practiced by the American people, still it is an easy matter when the new **PHILO SYSTEM** is adopted.

The Philo System Is Unlike All Other Ways of Keeping Poultry.

and in many respects is just the reverse, accomplishing things in poultry work that have always been considered impossible, and getting unheard of results that are hard to believe without seeing; however, the facts remain the same and we can prove to you every word of the above statement.

The New System Covers All Branches of the Work Necessary for Success,

from selecting the breeders to marketing the product. It tells how to get eggs that will hatch, how to hatch nearly every egg and how to raise nearly all the chicks batched. It gives complete plans in detail how to make everything necessary to run the business and at less than half the cost required to handle the poultry business in any other manner. There is nothing complicated about the work, and any man or woman that can handle a saw and hammer can do the work.

Two Pound Broilers in Eight Weeks

are raised in a space of less than a square foot to the broiler without any loss and the broilers are of the very best quality, bringing here, three cents per pound above the highest market price.

Our Six Months Old Pullets Are Laying at the Rate of 24 Eggs Each per Month

in a space of two square feet for each bird. No green cut bone of any description is fed, and the food used is inexpensive as compared with food others are using.

Our new book, the **Philo System of Progressive Poultry Keeping,** gives full particulars regarding these wonderful discoveries with simple, easy to understand directions that are right to the point, and 15 pages of illustrations showing all branches of the work from start to finish.

Don't Let the Chicks Die in the Shell.

One of our secrets of success is to save all the chickens that are fully developed at hatching time, whether they can crack the shell or not, It is a simple trick and believed to be the secret of the Ancient Egyptians and Chinese which enabled them to sell the chicks at 10 cents a dozen.

Chicken Feed at 15 Cents a Bushel.

Our book tells how to make the best green food with but little trouble and have a good supply any day in the year, winter or summer. It is just as impossible to get a large egg yield without green food as it is to keep a cow without hay or fodder.

Our New Brooder Saves Two Cents on Each Chicken.

No lamp required. No danger of chilling, overheating or burning up the chickens as with brooders using lamps or any kind of fire. They also keep all lice off the chickens automatically or kill any that may be on when placed in the brooder. Our book gives full plans and the right to make and use them. One can be easily made in an hour at a cost of 25 to 50 cents.

A FEW TESTIMONIALS.

Your system of poultry keeping should appeal to all poultrymen. The advantages of your system are many, and the quality of the large flock of poultry you have raised on your city lot is the best evidence of its success.
Geo. L. Harding, Binghamton, N. Y.

Valley Falls, N. Y., Sept. 5, 1907.
It was my privilege to spend a week in Elmira during August, during which time I saw the practical working of the Philo System of Poultry Keeping, and was surprised at the results accomplished in a small corner of a city yard. "Seeing is believing" they say, and if I had not seen, it would have been hard to believe that such results could have followed so small an outlay of space, time and money. (Rev.) W. W. Cox.

Windsor, Vt. March 8, 1908.
I consider the one dollar I invested in the Philo System, Poultry Review and American Poultry Advocate the best investment for the money I ever made. Robert L. Patrick.

Jacobs Creek, Pa.
I received the Philo System Book mailed to my home address. Beechtree, Pa. I am highly pleased with it, and am anxious to spread the good news as far as I can. I am a preacher of the gospel engaged by the Baptist Association to do Evangelistic work. I am on the road all the time, have about 14 days in each town. I am very much interested in the hen and will do all I can to help the other fellow to know how, and to spread the good tidings received in the Philo System. (Rev.) F. B. Williams.

SPECIAL INTRODUCTION OFFER By special arrangement we are able to give for only $1.00 the book, with the right to use all plans.

One year's subscription to Poultry Review. A monthly paper for utility breeders. One year's subscription to the American Poultry Advocate.

Upon receipt of $1.00 you will get the book by return mail and your subscriptions will start at once.

Copy of the Philo System book and a year's subscription to Poultry Review and the American Poultry Advocate, all for $1.

AMERICAN POULTRY ADVOCATE, 306 Hogan Block, SYRACUSE, N. Y.

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READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. **In every case it is necessary to give the number of the inquiry.** Where manufacturers do not respond promptly the inquiry may be repeated.

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VENDING MACHINES FOR GUM AND SWEETS. Send for descriptive circular. Foreign rights for sale. For full particulars address S-D Machine Company 465 Greenwich Street, New York City.

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WANTED.—Useful Novelties, practical tools, labor saving devices for use in shipping and packing departments. Any good articles which will facilitate shipping, packing or branding goods. Address B. & S. Co., Box 773, New York City.

Inquiry No. 8596.—Wanted to buy printed pillow tops for sofa pillows.

MACHINES TO FEED PAPER to ruling, folding, etc., machines. Cheapest and best. New patent. Limited territory. Sale or license to right party. Zimmerman, 1000 Tribune Bldg., Chicago.

Inquiry No. 8597.—Wanted to buy an alcohol furnace to heat a hot water system.

WE HAVE A LARGE FACTORY and are looking for something to manufacture. Prefer to buy an established business at a reasonable price. Louis Rastetter & Sons, Fort Wayne, Ind.

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HELP WANTED.

POSITIONS OPEN.—Salaries $600 to $5,000. Write today for "Brain Brokers" telling how we have placed 5,000 men. For full particulars address Hapgoods, 305 Broadway, New York.

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BOOKS AND MAGAZINES.

WIRELESS TELEGRAPHY.—Send 10 cents for special number of Electrician and Mechanic, devoted to this subject. Articles on how to make a 4-inch induction coil, magnetic detector, independent interrupter, indoor wireless, adjustment of detectors on tuned circuits, wireless telephony, storage batteries. Also hall seat, 16-foot launch, model engine, telephone installation, mechanical drawing, etc. List of electrical and mechanical books free. Sampson Publishing Company, 1151 Beacon Building, Boston, Mass.

Inquiry No. 8601.—Wanted an incandescent lamp burner for kerosene lamps.

GRE-SOLVENT.

GRE-SOLVENT instantly dissolves Machine grease, Paint, Ink, etc., from hands. Beneficial to skin. Sells like wildfire to every mechanic. Agents wanted. Big profits. Free sample. Do it now. Utility Co., 646 W. 44th St., N. Y. City.

Inquiry No. 8602.—Wanted to buy machinery and materials for incandescent gas mantle manufacture.

HOUSEHOLD NEEDS.

BUTCHER'S BOSTON POLISH is the best finish made for floors and interior woodwork. Not brittle; will not scratch or deface like shellac or varnish. Send for free booklet. For sale by dealers in Paints, Hardware and House Furnishings. The Butcher Polish Co., 356 Atlantic Avenue, Boston, Mass.

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DEAFNESS.

TO THOSE HARD OF HEARING.—An efficient aid sent for trial, no expense, no risk, no contract, no money unless device be kept. For full particulars address A. O. Tiemann & Company, 107 Park Row, New York.

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BUNGALOWS.

THE MAY NUMBER of American Homes and Gardens contains photographs and plans of big and little, costly and inexpensive bungalows, as well as articles on the furnishing of bungalows. Double number. Price, 50 cents. Order from your newsdealer or from Munn & Co., 361 Broadway, New York City.

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Inquiry No. 8645.—Wanted to buy parts for curling irons.

Inquiry No. 8646.—Wanted to buy cheap small motor from ¾ to 1 horse power, single phase 60 cycle, 110 volts.

Inquiry No. 8647.—Wanted to buy steel hat pins 8 inches pointed at both ends.

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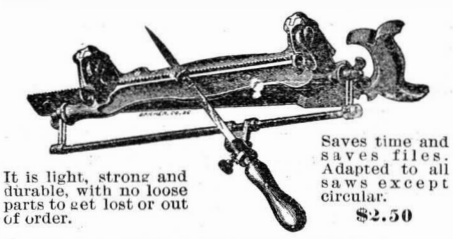

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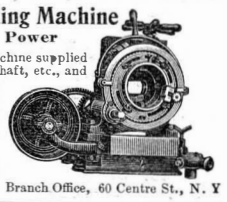

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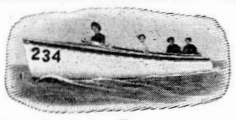

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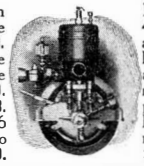

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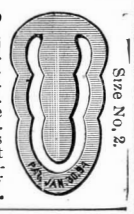

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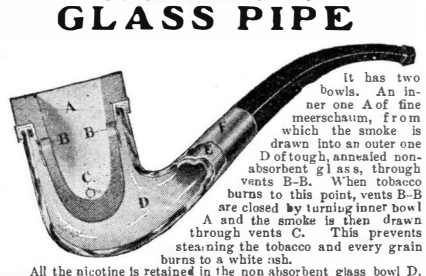

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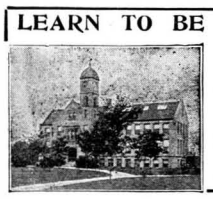

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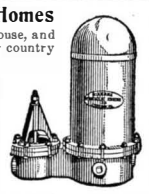

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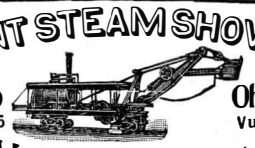

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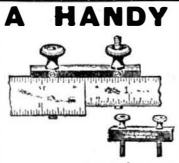

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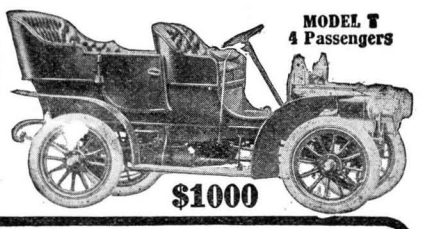

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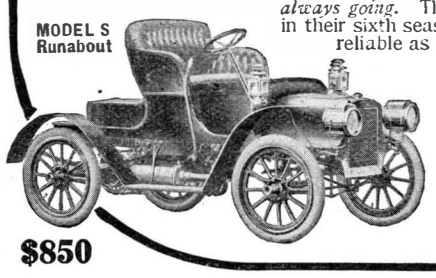

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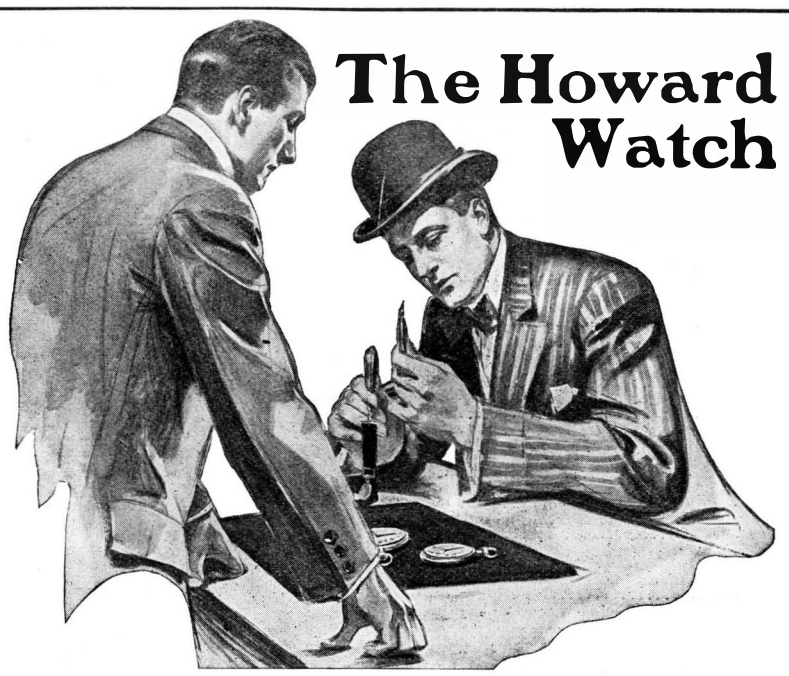

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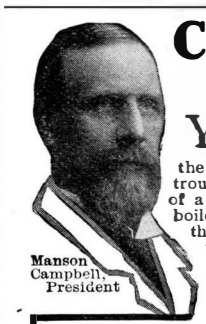

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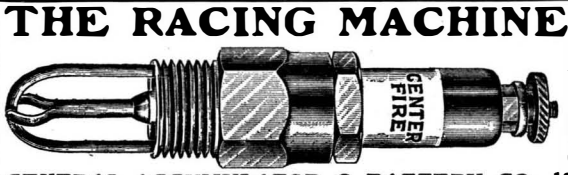

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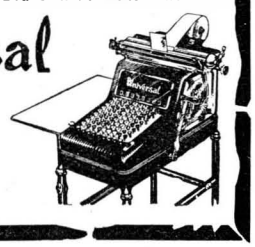

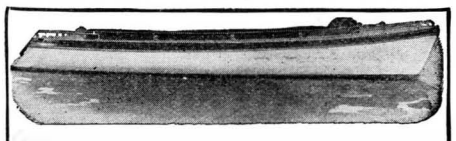

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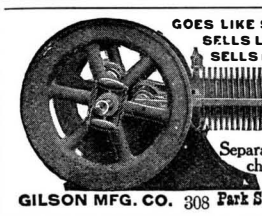

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